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# **Exploring the role of tactical decision games as a novel method of developing medical students' non-technical skills**

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**Doctor of Medicine – The University of Edinburgh - 2016**

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# **Abstract**

## **Introduction**

Clinical decision-making, situation awareness, task management, and teamwork are key non-technical skills (NTS) required by junior doctors. However, research has demonstrated that new doctors have difficulty demonstrating effective NTS behaviours. Tactical decision games (TDGs) are low-fidelity classroom-based activities designed to develop proficiency in NTS. They have been used in other safety-critical industries to develop NTS but their use in undergraduate medical education has been very limited. This aim of this thesis was to explore the potential role of TDGs as a novel method of developing final year medical students' NTS.

## **Methods**

Throughout this thesis a qualitative approach was taken, underpinned by constructivist epistemology. In the first instance the feasibility and acceptability of using generic (non-medical) TDGs with groups of final year medical students was explored. Thereafter, the use of non-medical TDGs and acute care simulation scenarios to develop NTS was investigated. Acute medical TDGs were developed with support and guidance from an expert panel. The potential role of medical TDGs to develop final year medical students' NTS was then explored. Medical TDGs were then implemented into the core undergraduate curriculum in the clinical assistantship programme.

## **Results**

In the feasibility study six key themes emerged from the data: “the value of non-medical games”; “giving and receiving feedback”; “observing and reflecting”; “recognizing and understanding NTS”; “dealing with uncertainty and ambiguity”, and “introducing TDGs into the curriculum”. Exploring the use of non-medical TDGs and acute care simulation to develop NTS, five key themes emerged from the data: “situation awareness and fixation”; “expectations influencing behaviour”; “being uncomfortable with uncertainty”; “transmitting and receiving information” and “working with peers and seniors”. Using acute medical TDGs to develop NTS, five key themes emerged from the data: “understanding capabilities and responsibilities of team members”; “prioritising in a busy clinical environment”; “developing a workable solution”; “relating medical TDGs to clinical experience” and “introducing medical TDGs into the undergraduate curriculum”. A team of facilitators were trained and medical TDGs delivered to the full final year cohort in the clinical assistantship programme.

## **Discussion and conclusions**

This thesis has found that generic and acute medical TDGs represent an exciting potential method of teaching medical students NTS. TDGs appear to be versatile activities that can be adapted to meet the needs of participants in different contexts. As such, the full potential of TDGs in the undergraduate curriculum and beyond remains to be explored.

# **Lay Summary**

## **Introduction**

Junior doctors assume responsibility for the management of patients from the beginning of their first post after graduation from medical school. In order to safely and effectively manage patients they require both adequate medical knowledge and also skills known as non-technical skills (NTS). These include making clinical decisions, prioritising tasks and working effectively in a team. Research has shown that many newly qualified doctors struggle with this latter group of skills. This thesis explores tactical decision games (TDGs), a novel method of developing NTS. In TDGs groups of participants are provided with a challenging scenario such as a plane crash or shipwreck scenario and have to work effectively in a team to develop a solution to the scenario.

## **Methods**

In the first instance the feasibility and acceptability of using non-medical TDGs with groups of final year medical students was explored. This involved using plane crash and shipwreck scenarios. Thereafter, the same non-medical TDGs scenarios were used in combination with clinical mannequin simulation scenarios to develop students' NTS. Medical TDGs were then developed with support and guidance from NTS experts. The potential for these medical TDGs to develop final year medical students' NTS was then explored. Medical TDGs were then implemented into the core undergraduate medical curriculum in the final year of the course.

## **Results**

In the feasibility study, the students valued using non-medical games, giving and receiving feedback, observing and reflecting on NTS and the uncertainty and ambiguity within the scenarios. The non-medical games and the mannequin simulation scenarios appeared to develop students' NTS in a clinical context.

Medical TDGs enabled students to understand capabilities and responsibilities of team members, prioritise tasks in a busy environment, develop a pragmatic/workable solution and relate the medical TDGs to their clinical experience. A team of facilitators were trained and medical TDGs delivered to the full final year cohort.

## **Discussion and conclusions**

This thesis has found that both non-medical and medical TDGs represent an exciting potential method of teaching medical students about the importance of NTS. TDGs appear to be versatile activities that can be adapted to meet the needs of participants in different contexts. As such, the full potential of TDGs in the undergraduate curriculum and beyond remains to be explored.



## **Declaration**

This thesis is submitted to the University of Edinburgh for the degree of Doctor of Medicine. The work herein was composed by Iain Drummond and carried out under the supervision of Professor Morwenna Wood, Director of Medical Education, NHS Fife and Dr Janet Skinner, Director of Clinical Skills, Centre for Medical Education, University of Edinburgh. I undertook all of the work myself except where stated otherwise in the body of the thesis and in accordance with the University of Edinburgh regulations governing the degree of Doctor of Medicine. This thesis has not been submitted in whole or in part for any other degree, diploma or professional qualification at this or any other university.

Signed:

Date:

## **Ethics**

Ethical approval for the studies carried out in Chapters 3-5 of this thesis was obtained from the University of Edinburgh College of Medicine and Veterinary Medicine Committee on the Use of Student Volunteers.

**Word count of main thesis:** 40, 670 (excluding references and appendices)

## **Research output**

During the period of research the following paper was published:

- 1) Drummond I, Sheikh G, Skinner J, Wood M. 2016. Exploring the feasibility and acceptability of using tactical decision games to develop final year medical students non-technical skills. *Medical Teacher* 38: 510-514.

During the period of research the following letter was accepted for publication:

- 1) Drummond I, Sheikh, G, Skinner J, Wood M. Response to: Can gaming turn doctors into better tacticians? *Medical Teacher* [in press]. Accepted November 2016.

During the period of research the following oral presentations were given at conferences:

- 1) Drummond ID, MacCrossan M, Klym S, Skinner J, Wood M. Tactical decision games (TDGs): an innovative and sustainable method of teaching non-technical skills (NTS) in acute medicine and nephrology. Scottish Renal Association (SRA), Inverness, 2016.
- 2) Drummond ID, Skinner J, Wood SM. Exploring the role of tactical decision games (TDGs) as a novel method of teaching non-technical skills (NTS). Association for Medical Education in Europe (AMEE), Milan, 2014.
- 3) Drummond ID, Skinner J, Wood SM. Exploring the role of tactical decision games (TDGs) as a novel method of teaching non-technical skills (NTS). Association for the Study of Medical Education (ASME), Brighton, 2014.
- 4) Drummond ID. Exploring the role of tactical decision games (TDGs) as a novel method of teaching non-technical skills (NTS). Scottish Clinical Skills

Managed Educational Network (CSMEN) Research and Development conference, Stirling, 2014.

During the period of research the following poster presentation was given at a conference:

- 1) Drummond ID, Sheikh G, Lamb T, Skinner J, Wood M. Exploring the influence of participating in tactical decision games on medical students' recognition and understanding of non-technical skills. Association for Medical Education in Europe (AMEE), 2015.

During the period of research I was nominated for the following prize:

- 1) Nominated for Association for Medical Education in Europe (AMEE) Patil Teaching Innovation Award for Short Communication "Exploring the role of tactical decision games (TDGs) as a novel method of teaching non-technical skills (NTS)", Milan, September 2014 (12 abstracts shortlisted from >800 submissions).

# Chapter 1: Introduction

The World Health Organisation (WHO) defines patient safety as “the freedom for a patient from unnecessary harm or potential harm associated with healthcare” (Walton et al. 2010). In recent years there has been increasing awareness of the impact of medical errors in contributing to patient morbidity and mortality. This has led to the growth of a patient safety culture and the realisation that errors are often related to human failings rather than intrinsic lack of knowledge and skills. Indeed, human error is estimated to be a major contributor in 70-80% of adverse outcomes or near misses (Glavin and Maran 2003).

A recent National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report retrospectively reviewed case records from patients who suffered an in-hospital cardiac arrest (Findlay et al. 2012). Cardiac arrest occurring whilst an in-patient is associated with a very poor outcome and almost always occurs following a period of clinical deterioration. The enquiry considered care to be good in only 29% of patients assessed in this study. Deficiencies were noted in the admission process, consultant involvement, decision-making about cardiopulmonary resuscitation (CPR) status, recognition of severity of illness and markers of risk, appreciation of urgency and requirement to escalate to more senior doctors.

Foundation doctors (doctors in the first two years of a UK training programme) are often the first doctors called to assess acutely deteriorating patients. The Foundation Programme Curriculum requires Foundation Doctors to be able to recognise the acutely unwell patient and initiate early management of these patients (UKFPO

2012). Clearly, they require adequate medical knowledge in order to assess and begin treatment of such patients. However, they also require a range of other skills, known as non-technical skills (NTS). These skills include clinical decision-making, task management, situation awareness, teamwork and communication (Flin et al. 2008; Mellanby et al. 2014). Despite the importance of NTS, there is growing recognition that new doctors have difficulty demonstrating effective NTS behaviour (Brennan et al. 2010; Kellett et al. 2014, Monrouxe et al. 2014; Tallentire et al. 2011a; Tallentire et al. 2011b).

Whilst NTS have sometimes been considered innate, there is evidence from other industries that NTS can be developed with training (Glavin and Maran 2003; Flin and Patey 2009). One such method that has been used in many safety critical industries is the tactical decision game (TDG) (Schmitt 1996; Flin et al 2008). This thesis explored TDGs as a potential novel method of developing medical students' NTS in preparation for working as Foundation doctors.

## **1.1 Difficulties exhibiting effective NTS behaviour**

In the UK, the GMC expect Foundation doctors to be able to demonstrate effective NTS behaviour from the point of graduation from medical school (GMC 2009; UKFPO 2012). However, there is growing recognition that new doctors have difficulty demonstrating effective NTS behaviour (Brennan et al. 2010; Kellett et al. 2014, Monrouxe et al. 2014; Tallentire et al. 2011a; Tallentire et al. 2011b). Specifically, junior doctors and their supervisors report challenges associated with clinical decision-making, prioritising workloads, inter-professional communication,

knowing when and how to escalate care and transferring knowledge into practice (Brennan et al. 2010; Kellett et al. 2014, Monrouxe et al. 2014; Tallentire et al 2011a; Tallentire et al. 2011b). These studies have concluded that medical schools should place increased emphasis on the development of NTS within undergraduate curricula. However, there has been little research that has sought to explore and understand potential strategies for developing medical students' NTS.

## **1.2 Human factors and NTS**

From the study of errors and safety both within medicine and other high-risk industries the term “human factors” has emerged and been defined as “the interactions between people and technical components in complex systems” (Catchpole et al. 2010). Human factors can be broadly categorised as system-level and person-level human factors. System-level human factors are the aspects that relate to managing the human element within the healthcare system such as equipment design, risk identification, incident investigation and assessment of new procedures (Catchpole et al. 2010). For example, a drug preparation area in a ward where there are frequent interruptions by people and telephones, insufficient workspace and high ambient noise levels might confer an increased risk of a drug administration error (Carthey 2013).

Person-level human factors are synonymous with non-technical skills (NTS). NTS are “the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance” (Flin et al. 2008). For

example, important NTS include decision-making, situation awareness, task management and teamwork (Flin et al 2008; Mellanby et al. 2014).

### **1.2.1 Situation awareness**

Situation awareness refers to an individual's "perception of the elements in the environment within the volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (Endsley 1995). For example, a physician may observe that the blood pressure has dropped and recognise that this may be due to one of a number of factors such as dehydration, bleeding or sepsis. The physician also needs to appreciate that the blood pressure may drop further if the underlying cause is not identified and treated. This may, for example, involve administering intravenous fluids, blood products or antibiotics. Situation awareness is a dynamic process that requires to be reassessed regularly, and in response to interventions, such as those described above. Situation awareness is a cognitive skill and therefore cannot be observed directly but rather is observed indirectly through task actions and communications. Real-time or immediate post-task interviewing is another technique for assessing situation awareness and is described in detail later in this thesis (Flin et al. 2009).

### **1.2.2 Decision-making**

Decision-making is "the process of reaching a judgement or choosing an option, sometimes called a course of action, to meet the needs of a situation (Flin et al. 2008)". More specifically, naturalistic decision-making describes "decision making in the real world, often under conditions of high uncertainty, time pressure and risk,

which can often be found in many safety-critical workplaces” (Flin et al. 2009). Adequate situation awareness is required to make effective decisions (Flin et al. 2008). For example, if the physician fails to recognise that the patient is bleeding then blood transfusion is unlikely to be administered in an appropriate timely manner.

### **1.2.3 Teamwork**

Teamwork describes “a dynamic process involving two or more people engaged in the activities necessary to complete a task” (Flin et al. 2009). Foundation doctors work in teams throughout their posts and require effective teamwork skills to provide safe and effective patient care (UKFPO 2012). Foundation doctors work in both horizontal and vertical teams. For example, in a horizontal team, two Foundation doctors and two nurses may work together to prescribe and safely administer a blood transfusion to a patient who has had a gastrointestinal bleed. The cardiac arrest team is an example of a more vertical team. This team is likely to be led by a senior registrar or consultant and effective resuscitation will require coordinated team effort.

### **1.2.4 Task management**

Task management is the skill of management of resources and organisation of tasks to facilitate achieving goals. This may include skills relating to planning and preparation, prioritisation, providing and maintaining standards and the identification and utilisation of resources (Mellanby et al. 2014). Foundation doctors require to prioritise both within the management of a single patient and when managing several



patients simultaneously. For example, they may need to decide whether to attend a patient with a low blood pressure before or after another patient with chest pain, recognising that delay in attending either patient could confer an increased risk of harm to that patient.

### **1.3 Identifying NTS**

It is important to define and understand key NTS required by different professional groups in order to design educational strategies that may develop NTS. Behavioural marker systems provide a framework for this process. A behavioural marker system is “a behaviour rating system based on a defined set of skills, with their component elements and associated examples of desirable and undesirable behaviours” (Flin and Maran 2004). Flin described the development of a behavioural marker system as a two-step process (Flin et al 2008). Firstly, the skills and related behaviours deemed to influence safe and efficient performance are identified. These skills and behaviours are identified by a variety of methods as shown in Figure 1, adapted from Flin et al. (2008).

**Figure 1 – Techniques to identify non-technical skills**

Type	Techniques
Event-based analyses: <i>Examining accident or near-miss reports to identify patterns of behaviours</i>	<ul style="list-style-type: none"><li>• Accident/near-miss analysis</li><li>• Confidential reporting systems analysis</li></ul>
Questioning techniques: <i>Soliciting information directly from role-holders from the job under investigation</i>	<ul style="list-style-type: none"><li>• Interview</li><li>• Focus groups</li><li>• Questionnaires and surveys</li></ul>
Observational techniques: <i>Watching individuals or teams carrying out one or more tasks</i>	<ul style="list-style-type: none"><li>• Direct</li><li>• Participant</li><li>• Remote (e.g. from video recording)</li></ul>

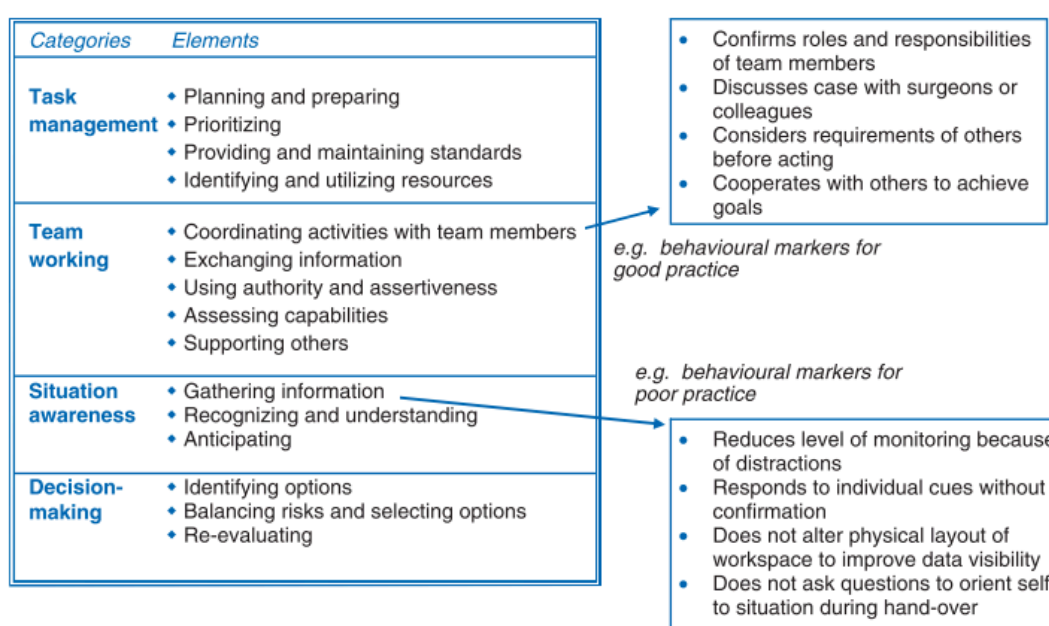
The resulting list is then refined and organised into a concise, hierarchical structure containing sub-components and examples of good and poor behaviours.

### **1.3.1 Behavioural marker systems in healthcare**

Different NTS are required by different healthcare professionals and so, within healthcare, different behavioural marker systems have been developed that describe the key NTS required by different groups of health care professionals. For example a consultant anaesthetist and a paramedic will require a different set of NTS. Many of these frameworks are similar and reflect overlap in the skills required by different groups of healthcare professionals.

One of the earliest developed behavioural marker systems in healthcare was the anaesthetists' non-technical skills (ANTS) framework, which was especially designed for anaesthetists (Flin et al. 2010). The ANTS framework was derived from a series of task analyses based on a literature review, observations, interviews, surveys and incident analysis (Flin et al. 2010). The ANTS framework is presented in Figure 2.

**Figure 2 – Anaesthetists' non-technical skills (ANTS) framework**



The framework was designed to meet a requirement for a practical tool that could be used to assess anaesthetists' performance in theatre or in a simulation setting. For example, during a perceived difficult intubation the anaesthetist must recognise the situation (a likely difficult airway), and recognise that this means a modification to standard intubation procedures, including realising that this is a high-risk situation. They must consider options to maintain a safe airway by balancing up risks and

benefits of different strategies. This may involve gathering additional equipment such as a fibre-optic scope and a team who are familiar with the situation. Each team member needs to have an allocated appropriate role, such as drawing up drugs, and crucially the team must have a clearly identified leader.

Gordon noted that there was no generic recognised framework of NTS in healthcare and used a modified Delphi approach to develop a NTS in healthcare competency framework (Gordon et al. 2015). He defined NTS in healthcare as “a set of social (communication and team working) and cognitive (analytical and personal behaviour) skills that support high quality, safe, effective and efficient multi-professional care within the complex healthcare system” (Gordon et al. 2015). He then described examples of effective NTS behaviour within each of the four main categories: communication, team working and inter-professional skills, personal behaviours and analytical skills. The framework is presented in Figure 3.

### **Figure 3 – Non-technical skills in healthcare competency framework**

#### **Definition**

- A set of social (communication and team working) and cognitive (analytical and personal behaviour) skills that support high quality, safe, effective and efficient multiprofessional care within the complex healthcare system.

#### **Social Factors**

##### **Communication**

- Uses language clearly
- Organises information
- Ensures receiver of information has understood
- Confirms understanding when receiving information

##### **Team working and interprofessional skills**

###### **ALL**

- Exchanges relevant information within the team
- Focuses on the patient and their care when conflict arises
- Values team input

###### **LEADERS**

- Seeks and takes responsibility when appropriate
- Identifies when colleagues are struggling and acts appropriately
- Monitors and reviews task progress within the team
- Coordinates workload with colleagues
- Assesses capabilities of individuals within the team
- Demonstrates shared planning with team

#### **Cognitive factors**

##### **Personal behaviours**

- Displays personal attributes of compassion, integrity and honesty
- Applies critical self-appraisal
- Welcomes feedback on performance
- Identifies when stress may pose a risk
- Recognises feedback and considers appropriate actions to negate risk

##### **Analytical skills**

###### **ALL**

- Gathers and analyses information to support awareness of risk of errors
- Changes trajectory when significant risk is encountered
- Identifies viable options available
- Re-evaluates based on situational awareness

###### **LEADERS**

- Encourages active dialogue within the team regarding risk
- Anticipates potential future risks for the team

Gordon suggested that curriculum developers, educational innovators and clinical teachers could use the framework to support developments in the field. However, the framework is somewhat generic and does not focus on the NTS required by a particular group, such as Foundation doctors.

Mellanby recognised that the NTS required by Foundation doctors had not been clearly defined and used a mixed-methods approach to define the key NTS required by junior doctors working in acute care in the UK (Mellanby et al. 2014). He developed a behavioural marker system by literature review, critical incident interviewing and expert panel consensus and then validated the prototype framework through observing simulation scenarios. The final framework consisted of four key categories: situation awareness, decision-making, task management and teamwork (Mellanby et al. 2014). Each category had three or four sub-categories and examples of effective and ineffective NTS behaviour. The framework is presented in Figure 4.

**Figure 4 – Behavioural marker system for junior doctors in acute care**

<b>Category</b>	<b>Element</b>
Situational awareness	Gathering information Recognising and understanding Projection to future states
Decision making	Generating options Balancing options Reviewing of decisions
Task management	Prioritising (tasks and patients) Maintaining standards Being prepared Utilising resources
Teamwork	Speaking up Establishing shared understanding Establishing a team

As with other behavioural marker systems, Mellanby defined each component element and described positive and negative exemplar behaviours. For example, prioritising (tasks and patients) is shown in Figure 5.

**Figure 5 – Prioritising (tasks and patients) exemplar positive and negative behaviours**

**Descriptor:** Prioritising tasks and patients according to importance and avoiding being distracted by less important or irrelevant matters.

Positive exemplar behaviours	Negative exemplar behaviours
<ul style="list-style-type: none"> <li>• Maintains and reviews task list frequently</li> <li>• Allocates attention to sickest patients first</li> <li>• Makes priorities clear to other members of team</li> <li>• Uses A to E approach to prioritise interventions in unwell patients</li> <li>• Requests investigations and makes referrals early to accommodate inherent system delays</li> <li>• Recognises when input no longer needed</li> </ul>	<ul style="list-style-type: none"> <li>• Does tasks in inflexible or haphazard order</li> <li>• Does not seek information on clinical condition or required urgency of allocated tasks</li> <li>• Delays doing unfamiliar, difficult or unpleasant tasks</li> <li>• Accommodates staff/admin demands over needs of patients</li> <li>• Concentrates on individual tasks without attempting to relate one task to another</li> </ul>



Behavioural marker systems use observable behaviours to enable NTS to be recognised, categorised and assessed. Mellanby's behavioural marker system was the first behavioural marker system developed specifically for novice practitioners. Mellanby envisaged that the framework would mainly be used in simulated clinical scenarios, informing the design and iterative development of the scenarios and providing an anchor for debriefing and feedback. For example, the behavioural marker system has been used to inform scenario design and provide targeted feedback during debriefing for simulated acute care training at the University of Edinburgh and throughout Lothian for Foundation Year simulation training.

Brown recognised that a particular challenge for junior doctors were the NTS required when working out-of-hours (Brown et al. 2015). He defined out-of-hours as outwith the period between 0900 and 1700 from Monday to Friday, the period when care is provided by a reduced number of doctors. This is a particularly challenging time for Foundation doctors as they often work in fluid teams, covering a large number of unfamiliar patients in unfamiliar ward areas, relying on handover information from colleagues. Brown performed a survey-based cross-sectional study to identify the key NTS required by junior doctors when working out-of-hours. In this context, task prioritisation was consistently identified as the most important NTS, reflecting the need to prioritise amongst patients. Brown also found that communication with colleagues was ranked as more important than communication with patients in the provision of safe and effective care out-of-hours. Whilst communication skills form an important part of the medical curriculum, emphasis has usually been on communication with patients, rather than with colleagues. Given

the importance of communication with colleagues and difficulties that junior doctors report with this skill, it is surprising that this skill has received relatively little attention, apart from patient safety approaches to standardising communication, such as the SBAR tool. SBAR is an acronym for “situation, background, assessment and recommendation” and has been used as a standardised communication tool in various healthcare contexts (NHS Scotland, Quality Improvement Hub).

## **1.4 Importance of NTS**

Most cases of medical error can be attributed, at least to some extent, to ineffective NTS behaviour (Hogan et al. 2012; Richardson et al. 2000). Hogan performed a retrospective case record review of 1000 adults who died in 2009 in ten acute hospitals in England (Hogan et al. 2012). She found death to be considered preventable in 5.2% of cases. The principal problems associated with preventable deaths were poor clinical monitoring (31%), diagnostic errors (30%) and inadequate drug or fluid management (21%). Hogan extrapolated her findings to suggest there would have been 11,859 preventable deaths among adults in acute hospitals in England in 2009.

In the report “To err is human: building a safer health system” Richardson estimated that at least 44,000 people, and perhaps as many as 98,000 people, die in United States hospitals each year as a result of medical errors that could have been prevented (Richardson et al. 2000). Richardson found that errors are commonly caused by faulty systems, processes and conditions that lead people to make mistakes or fail to prevent them. The report argued that health care, at that time, was “a

decade or more behind many other high-risk industries in its attention to patient safety” and recommended that healthcare organisations must develop a “culture of safety” such that workforce and processes are focussed on improving patient safety.

Reason argued for a “systems approach” to the management of errors, arguing that human fallibility is an inevitable source of error and errors are to be expected, even in the best organisations (Reason 2000). Central to the idea of a systems approach is the concept of “defences” and understanding how and why defences fail. Reason argued that errors are inevitable but high reliability organisations work hard to build defences to avert errors or mitigate their consequences.

In 2007 the Association for the Study of Medical Education in Europe (AMEE) recommended that patient safety education be integrated from the start of existing undergraduate courses (Walton et al. 2010). To address the requirement for patient safety education in medical schools the World Health Organisation (WHO) World Alliance for Patient Safety sponsored the development of a patient safety curriculum for medical schools. The objectives of the WHO Patient Safety Curriculum Guide are presented in Figure 6 (Walton et al. 2010).

**Figure 6 – Objectives of the WHO Patient Safety Curriculum Guide for Medical Schools**

- To prepare medical students for safe practice in the workplace
- To inform medical schools of the key topics in patient safety
- To enhance patient safety as a theme throughout the medical curriculum
- To provide a comprehensive curriculum to assist teaching and integrating patient safety learning
- To further develop capacity for patient safety educators in medical schools
- To promote a safe and supportive environment for teaching students about patient safety
- To introduce or strengthen patient safety education in medical students worldwide
- To raise the international profile of patient safety teaching and learning
- To foster international collaboration on patient safety education research in the higher education sector

Walton advocated that students need both theoretical underpinning knowledge about patient safety as well as knowing how to apply the principles and concepts in clinical areas. Recommended teaching and learning activities included lectures, case-based examples, small group discussions, simulation exercises, role-play scenarios, team-building exercises and reflective activities.

In the United Kingdom, the Parliamentary Inquiry into Patient Safety noted “serious deficiencies in the undergraduate medical curriculum which are detrimental to patient safety” and recommended training in NTS (Flin and Patey 2009). Flin argued that undergraduate and early professional education in NTS would provide essential understanding of the physiological, psychological and social factors that may influence clinical performance (Flin and Patey 2009). She also emphasised that restricting NTS education to the postgraduate environment may be too late: professional attitudes are formed during undergraduate training and NTS education in the postgraduate curriculum may be undervalued if it is not also included in the undergraduate curriculum.

## **1.5 NTS training in aviation**

Aviation was one of the first safety-critical industries to recognise the benefits of and indeed mandate regular NTS training. This occurred in response to a series of major aviation disasters where ineffective NTS behaviours contributed to the accidents occurring (Flin et al. 2008). For example, in the Tenerife crash in 1977, two jumbo jets crashed on an airport runway due to confusion regarding clearance to take off. The captain of one of the planes, who over-ruled the engineer, disregarded concerns

by a flight-deck engineer. Retrospective analyses of the accident revealed problems relating to communication with air traffic control, team coordination, decision-making, fatigue, and leadership behaviours (Flin et al. 2008).

In response to these incidents the aviation industry introduced a programme of NTS training. Crew Resource Management (CRM) programmes are used to teach pilots and other members of airline teams about the importance of NTS. CRM is defined as “a set of instructional strategies designed to improve teamwork in the cockpit by applying well-tested tools (e.g. performance measures, exercises, feedback mechanisms) and appropriate training methods (e.g. simulators, lectures, videos) targeted at specific content (i.e. teamwork knowledge, skills and attitudes) (O’Connor et al. 2008). The regulators of civil aviation in the UK and USA made CRM training mandatory for pilots in 1992 and 1998 respectively (O’Dea et al. 2014). It is noteworthy that this decision was made on a body of evidence supporting CRM training effectiveness that is far weaker than that which exists in the healthcare industry today (O’Dea et al. 2014).

CRM training is embedded from the beginning of training and it is made explicit that technical skills alone are inadequate to ensure a safe flight (Flin and Patey 2009). The basis of CRM training is that it provides a set of countermeasures against human error by developing NTS (Glavin and Maran 2003). A core concept of CRM training is that it strives to make individuals more effective in whichever team they are working in rather than strengthening any particular team (Flin et al. 2008). This

may be particularly important for Foundation doctors as they work in multiple, frequently changing fluid teams.

CRM training can be very heterogeneous in nature but critical elements of CRM training include the opportunity for practice, formative feedback and tools to support the transfer of training to the professional environment (O'Dea et al. 2014).

Teaching methods used in CRM training may include lectures, discussions, role-play exercises, case studies, accident analyses and video re-enactments of accident scenarios (Flin et al. 2002). O'Connor undertook a meta-analysis to investigate the effectiveness of CRM training. Encouragingly, he found that CRM training had large effects on participants' attitudes and behaviours and a medium effect on their knowledge (O'Connor et al. 2008).

## **1.6 NTS training in healthcare**

Healthcare has been slower than other safety-critical industries to address NTS and human factors training. Indeed, the first Clinical Human Factors group that has both clinical and human factors specialists involved was not established in the UK until 2007 (Flin et al. 2009). Martin Bromiley, an airline pilot whose wife Elaine Bromiley died due to a preventable anaesthetic accident that had NTS causes, established this group (Bromiley 2008). Elaine Bromiley died in the context of a failed intubation "can't intubate, can't ventilate scenario". The anaesthetic team became fixated on the need to intubate, failing to recognise that the key priority was to achieve safe ventilation. The anaesthetist did not respond to a nurse offering a tracheotomy kit and it appeared in retrospect that other nurses were aware of what

was happening but felt unable to speak up. Crucially, the team had adequate technical skills but the patient died due to inadequate NTS behaviours.

Flin noted as recently as 2013 that no specialist human factors group exists in the National Health Service (NHS), in contrast to every other safety critical industry (Flin et al. 2013). Flin argued that the criteria in Figure 7 are essential for patient safety in the NHS.

**Figure 7 – Prerequisites for patient safety (from Flin et al. 2013)**

- Analysis of accidents should include an examination of “human factors issues”, especially workplace behaviours
- The findings from these analyses must be linked to on-going training of the behaviours that constitute non-technical skills in healthcare
- Humans will always be prone to fail in systems that have not been designed using ergonomics/human factors principles

Domain-specific behavioural marker systems, such as the ANTS system described earlier in this chapter, have been used to map NTS training for specific professional groups. The behavioural marker system identifies the NTS required by a particular professional group and then NTS training programmes are developed that target these NTS. For example, ANTS was used to develop a NTS training programme for anaesthetists: Crisis Avoidance and Resource Management for Anaesthetists (CARMA) (Flin and Maran 2004). This programme involved formal presentations to deliver underlying theory followed by case based discussion and small group



exercises. Simulation scenarios were used to put NTS learning into practice and debriefing done using the ANTS framework. For example, this may involve a failed intubation drill, which targets the NTS that failed in the case of Elaine Bromiley. CARMA evaluation suggested that the course was positively received and participants intended to apply learning to practice, particularly around improving communication and team working and reviewing aloud. Of course, this type of evaluation only describes positive reactions and an *intention* to modify behaviour in the clinical environment. It does not necessarily mean that such behavioural change occurred.

## **1.7 Measuring impact of NTS training**

Measuring the impact of NTS training can be challenging. Perhaps the best known-model that has been used to measure NTS training is Kirkpatrick's model of evaluation. Kirkpatrick described a hierarchy of interventional impact (Flin et al. 2008). Kirkpatrick's model is presented in Figure 8.

**Figure 8 – Kirkpatrick’s model of evaluation**

<b>Level</b>	<b>Description</b>	<b>Example Evaluation Technique</b>
Level 1 Reactions	How did participants react to the training?	Paper-based questionnaire e.g. Likert scale +/- free text response
Level 2 Learning	Whether the participants acquired knowledge, or have modified their attitudes or beliefs	Paper-based attitude questionnaire Paper-based knowledge test
Level 3 Behaviour	Assessment of whether knowledge learned in training transferred to behaviour on the job or a similar simulated environment	Observation e.g. using behavioural marker systems
Level 4 Organisation	Tangible difference at an organisational level, such as an improvement in safety and productivity	Patient mortality, waiting times etc

Kirkpatrick went on to outline the pitfalls of only carrying out an evaluation at levels three or four of the hierarchy (Flin et al. 2008). Specifically, reactions may have been favourable or learning occurred even if there was no measured behavioural or organisational change. In some situations, participants may express motivation to

change behaviour following NTS training. This may be a good outcome in itself, but follow-up work may be required to determine whether they subsequently modified their behaviour in the workplace. It may then be difficult or indeed flawed to attribute behavioural change to a single training course. Despite difficulties in measuring the impact of NTS training in healthcare, many studies have attempted to do so leading to a body of evidence supporting the efficacy of NTS training.

## **1.8 Impact of NTS training in healthcare**

Gordon performed a systematic review of NTS training in healthcare (Gordon et al. 2012). He described considerable confusion surrounding what indeed constitutes CRM training and its educational underpinnings. None of the studies included in the systematic review presented detail on the theoretical orientation of the intervention and it was suggested the lack of a theoretical model to guide NTS training appears to be a reflection of the same deficiency within CRM training in other industries.

Gordon also found that few studies investigated higher-level outcomes from Kirkpatrick's hierarchy, and specifically a lack of outcomes that supported the transfer of knowledge, skills and attitudes into behaviour change and reductions in adverse events. Gordon concluded that published work should clearly describe interventions and their theoretical underpinnings, and should aim to further explore which specific aspects of interventions are effective and why. This may make it easier for the reader to assess the potential transferability of findings to their own healthcare contexts.

O'Dea applied meta-analysis techniques to quantify the effectiveness of CRM-type training in acute care healthcare settings (O'Dea et al. 2014). O'Dea found a large effect of training on participants' knowledge, a small effect on attitudes and a large effect on behaviours. However, there was insufficient evidence to support an effect on clinical care outcomes or long-term impacts. It is also noteworthy that six of the eight studies that measured behaviour did so in a simulated environment, rather than in a real-world clinical setting. O'Dea concluded that CRM training could positively impact teamwork in healthcare but more robust research design and more multi-level, multicentre, multispecialty and longitudinal studies were required.

Given the heterogeneity of study designs and outcome measures used to evaluate NTS training in healthcare, narrative synthesis of the literature has been applied more often than meta-analysis or systematic review. For example, Weaver undertook a narrative synthesis of the literature evaluating team-training interventions in healthcare (Weaver et al. 2014). Sixty-eight per cent of programmes used simulation-based activities, including physical simulation, standardised patients, cognitive simulations and role-play exercises. Weaver found that moderate-to-high quality evidence suggests that team training can positively impact healthcare team processes and patient outcomes. She found evidence for improvements in teamwork knowledge, attitudes and team processes during shorter term evaluations and a growing body of robust evidence for longer-term impact on real or potential patient harm outcomes. It is noteworthy that studies demonstrating the most robust evidence for effectiveness implemented team training as a "bundled intervention", along with

learning activities and tools to support and maintain transfer of learning into the workplace.

Two studies describing improved patient outcomes at an organisational level following NTS training warrant particular mention (McCulloch et al. 2009; Neily et al. 2010). Neily evaluated the association between implementation of a CRM-informed team training programme and surgical mortality (Neily et al. 2010).

Theatre teams attended a learning session as a team. The learning session included a lecture, group interactions and videos. After the learning session, four quarterly follow-up structured telephone interviews were conducted with the team for one year to support, coach and assess the team training implementation. Facilities that had received the training were also required to implement theatre briefings and debriefings. One year after implementation of the programme the decline in the risk-adjusted surgical mortality rate was 50% greater in groups that had implemented the programme compared with contemporaneous cohorts. Moreover, the surgical mortality rate decreased further in groups that continued to implement the programme beyond one year. It is unclear, however, exactly which aspects of the CRM training were effective but the on-going telephone support and the mandatory theatre briefings and debriefings are noteworthy.

McCulloch performed an uncontrolled before and after study investigating the effects of NTS training on technical performance and outcome in the operating theatre (McCulloch et al. 2009). Team members received nine hours of a mixture of didactic and interactive NTS teaching. Following the classroom course, teams were

supported in theatre by twice-weekly visits from aviation CRM trainers, who provided encouragement, coaching and feedback for a 3-month period. NTS training resulted in improvements in attitudes to safety, team non-technical performance and technical error rates both in the operative field and outside it. The training programme led to improvements in teamwork and cooperation, problem solving and decision-making. The authors acknowledged that it was not clear which aspects of the NTS training led to these improvements, however the on-going support from the aviation CRM trainers is again noteworthy.

## **1.9 Developing NTS training**

NTS training in healthcare has largely been restricted to staff who work in well-defined teams such as in the operating theatre (Catchpole et al. 2010). This training contrasts with much of the CRM training in aviation that equips individuals with transferable NTS that they can subsequently deploy in different contexts. Junior doctors tend to work in less well-defined and more fluid teams and have hitherto received very little NTS training. Additionally, in other industries sessions have often taken place in hierarchical teams, replicating the reality of naturalistic settings.

Given the importance of effective NTS behaviour and the potential benefits of NTS training there is an urgent need to understand how medical schools can develop students' NTS to ensure that they are better equipped when they begin working as doctors. Such strategies should focus both on development of awareness of the importance of NTS and on enabling the application of more effective NTS behaviour

(Catchpole et al. 2010). This may in turn translate into safer patient care and less medical errors.

Just as different NTS are of varying importance in different safety-critical industries, it cannot be assumed that NTS-training developed in one context will transfer across different domains (Catchpole 2013). For example, prioritisation of tasks has been identified as a more prominent NTS for junior doctors than in other industries and indeed elsewhere in healthcare (Mellanby et al 2014; Brown et al. 2015). Catchpole cautioned that human performance in healthcare systems is extremely complex, and the aviation CRM model, which does not address the level of individual, goal, task, evidential or conceptual complexity of clinical work, is insufficient to develop improved systems designs or better training (Catchpole 2013).

However, we can learn from the experience of other industries and lessons learned in other contexts may be applicable to healthcare contexts. Furthermore, some NTS training methods used in other industries may be of value in healthcare, provided they are adapted to meet the needs of participants. These training methods include high and low fidelity simulations and classroom exercises including case studies, discussions and accident analyses (Flin et al. 2002).

## **1.10 Tactical decision games**

One method of developing NTS that has been used extensively in safety-critical industries is the tactical decision game (TDG) (Schmitt 1996; Flin et al. 2008).

TDGs are used to teach adaptability and critical and reflective thinking: *how* to think

rather than *what* to think (Vandergriff 2006). The theoretical principles underpinning TDGs are not new and indeed Vandergriff notes that the Chinese general and military theorist Sun Tzu was advocating their use more than 2500 years ago (Vandergriff 2006)!

In the modern era, the term TDG was probably first developed by the US Marines (Schmitt 1996; Flin et al 2008). The US Marines developed TDGs as a tool for developing better decision-making, particularly in conditions of uncertainty (Schmitt 1996). Indeed, Major John Schmitt (formerly US Marines) has developed many TDGs and made them widely available through publication in the Marine Corps Gazette. TDGs are facilitated simulations using brief written scenarios, ranging in complexity, designed to exercise decision-making and other NTS (Schmitt 1996; Flin et al. 2008). TDGs are low-fidelity activities requiring just a room, carefully written scenario(s), willing participants and a skilled facilitator. TDGs may intentionally contain elements of uncertainty due to missing and sometimes ambiguous information and further information may be introduced in the course of the scenario. Working in a team, participants are presented with a challenging scenario and have a limited period of time to develop a workable solution to the scenario. TDGs are not intended to have a clear single-best solution. Indeed, participants have much to learn from alternative strategies developed by their peers (Crichton and Flin 2001). What is important is that participants make decisions in the time available and are able to justify the decisions they have made (Crichton and Flin 2001). A facilitator then leads discussion around the decisions made and the rationale underpinning these decisions. In addition to uncertainty and ambiguity,



Schmitt recommended that TDGs should be: interesting, challenging, plausible, accurate, contain the right amount and proper type of detail, allow for multiple interpretations and solutions and have a reasonable time limit (Schmitt 1996).

Crichton summarised the objectives of TDGs and these objectives are presented in Figure 9 (Crichton et al. 2000).

**Figure 9 – Objectives of Tactical Decision Games (from Crichton et al. 2000)**

- To exercise and practise decision making skills and illustrate key operating principles
- To boost expertise in decision making and judgement
- To assist participants to develop a shared understanding and recognition of possible problems
- To build up a repertoire of patterns which can be quickly recognised and acted upon, particularly during emergency situations
- To practise NTS such as decision-making, communication, situation awareness, stress management and teamwork

### **1.11 TDGs in safety-critical industries**

Both generic and domain-specific TDGs have been widely used in high-risk industries including the military, aviation, nuclear power, oil and gas and the prison service (Schmitt 1996; Crichton et al. 2000). Schmitt used both historical battles and his own military experiences as a starting point for developing realistic domain-specific scenarios (Schmitt 1996). Domain-specific TDGs developed in one context

can be used as generic/non-domain TDGs in another context. For example, a military scenario developed by Schmitt was used to introduce nuclear power industry workers to NTS (Crichton et al. 2000). In this scenario, participants were asked to take on the role of a Tank Division Commander and to decide where and how to deploy the Division when faced with enemy troops.

Crichton also described a domain-specific TDG scenario presented to Scottish Prison Service supervisors and unit managers at Peterhead prison (Crichton et al. 2000). This example scenario is presented in Figure 10.

**Figure 10 – Example domain-specific tactical decision game used with Scottish Prison Service supervisors and unit managers**

*“It is 20.30 on a Friday night in December. You (the supervisor) are in your office counselling a prisoner who is distraught after receiving news that one of his family has been killed in a car crash whilst en route to the prison for a visit; the prisoner also has a history of suicidal behaviour. Suddenly an officer bursts into your office and tells you that there is a fire in the top-flat ablutions area. There are 64 unlocked prisoners and five officers in the hall.”*

The participants had to answer two questions:

- **What are you going to do?**
- **How are you going to do it?**

### **1.11.1 Evaluating TDGs in safety-critical industries**

When TDGs were used in their original setting, a decision skills training programme for US Marine Corps squad leaders, participants reported that training helped to boost expertise in decision-making and judgement, meaning they felt better prepared to make difficult decisions under uncertainty and time pressure (Klein 1998).

Participants from the oil and gas drilling industry attending a single-day TDGs workshop reported that the TDGs were a useful opportunity to practise decision-making, receive feedback on performance and improve team performance (Crichton

2009). Scottish Prison Service supervisors reported that the experience helped with decision-making, understanding the nature of crisis management and also with confidence. They were also less reliant on standard operating procedures, more willing to take risks and to learn with colleagues (Crichton et al. 2000). For example, three weeks after participating in the domain-specific TDG presented in Figure 10, a major fire deliberately started by a prisoner, engulfed a residential hall. The supervisor reported that the TDG had helped his mental state of preparedness and that decisions came easily (Crichton et al. 2000). Nuclear power industry workers attending a generic and domain-specific TDG session reported that participation helped them to exchange ideas, consider options, learn from the experience of others, gain insight into other people's roles and identify issues they had not previously considered (Crichton et al. 2000).

## **1.12 TDGs in healthcare**

Given that medicine is a high-risk industry where NTS are of vital importance it is perhaps surprising that there is a paucity of literature describing the use of TDGs in healthcare contexts. Given the complexity of clinical medicine and indeed the ethos of CRM training it may be more appropriate to use TDGs to help develop a transferable set of skills that can be applied to different scenarios rather than expecting participants to encounter very similar scenarios in TDGs and then in subsequent clinical practice. However, it may also be possible to build up experience of common clinical situations through TDG participation.

Flin described developing and incorporating a programme of domain-specific TDGs into the core programme for all new starts in anaesthesia (Flin et al 2010; Patey et al. 2013). In the activity anaesthetics trainees considered the use of NTS in general and their influence on decision-making during emergencies. Participants found the activity realistic and useful. They reported learning about hospital procedures, equipment and locations. Learning review analysis, using the ANTS system as a framework, indicated that participants also improved their anticipatory skills, task management and team working skills. Participants also transferred their new knowledge by applying it to subsequent scenario cases more readily than previously. Despite this encouraging data, at the start of this period of research, extensive literature searching revealed no further examples describing the use of TDGs in healthcare contexts.

### **1.13 Conclusion**

This introductory chapter has described the crucial importance of NTS for the delivery of safe and effective healthcare. The key NTS required by Foundation doctors are situation awareness, decision-making, task management and teamwork. Foundation doctors and their supervisors have reported that newly qualified doctors have difficulties exhibiting effective NTS behaviour. TDGs have been introduced as a technique that has been used to develop NTS in a variety of safety-critical industries. However, their use in medicine appears to have been limited to the postgraduate setting of anaesthetics. It cannot be assumed that NTS training that has been effective in other safety-critical industries will also be effective in the

undergraduate medical curriculum. As such, the intriguing possibility of using TDGs to develop NTS in undergraduate medical students remains to be explored.

## **Chapter 2 - Aims and Methods Overview**

### **2.1 Introduction**

Chapter 1 described the key NTS required by UK doctors within the first two years of clinical practice and the difficulties reported by junior doctors and their supervisors exhibiting effective NTS behaviours. The importance of NTS on patient safety outcomes was illustrated. Strategies to develop NTS were highlighted, initially using aviation as an example of effective NTS training in another safety-critical industry. Thereafter, the impact of NTS training in healthcare was discussed including examples of educational impact at a behavioural level and indeed on occasions at an organisational level. TDGs were introduced as an example of a low-fidelity low-cost intervention that has been used to develop NTS in safety-critical industries. Their hitherto limited use in healthcare education was then described. The potential role of TDGs to develop NTS in undergraduate medical students did not appear to have been explored.

This chapter will describe the overall aim of this thesis along with the objectives of subsequent individual thesis chapters. It will describe the theoretical perspectives that have underpinned this work together with a “higher-level” overview of the methodologies applied in different phases of the work. Subsequent chapters will provide more detail of methods applied in different phases at a more operational level.

## 2.2 Thesis aims

The overarching aim of this thesis was to:

- “Explore the role of TDGs as a novel method of teaching final year medical students NTS”.

This hypothesis was informed by the following assumptions:

- NTS are crucial for the delivery of safe and efficient healthcare.
- Foundation doctors have difficulty exhibiting effective NTS behaviours.
- Whilst NTS have often been considered innate, they can be developed through training.
- NTS training can lead to an improvement in clinical performance.
- TDGs are a low-fidelity tool that have been used to good effect to develop NTS in other safety-critical industries.
- The potential role of TDGs to develop undergraduate medical students’ NTS had not previously been explored.

The following objectives were set in order to answer the overarching research question:

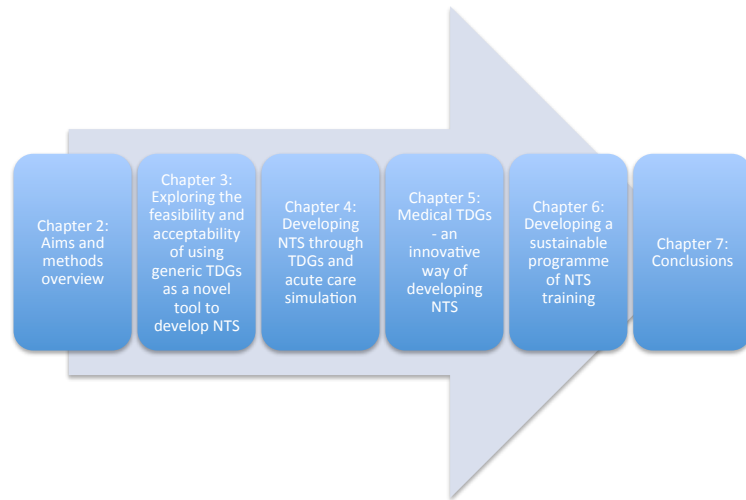
- To explore the feasibility and acceptability of using generic TDGs as a novel tool to develop NTS in final year medical students.
- To explore if generic TDGs and acute care simulation could be used in a complementary way to develop final year medical students’ NTS.
- To explore the potential role of acute medical TDGs as a novel method of developing final year medical students’ NTS.



- To develop a sustainable programme of NTS training that would be of lasting value in the Edinburgh medical curriculum beyond the lifespan of the work presented in this thesis.
- To highlight the wider potential role of TDGs in healthcare education and potential areas of future research.

The structure of this and subsequent chapters is presented in Figure 11.

**Figure 11 – Flow diagram detailing structure of thesis**



Throughout this thesis the term “generic” is used to refer to non-medical TDGs.

Examples of generic TDGs are provided in subsequent chapters. The term “medical TDGs” refers to domain-specific activities and again examples of medical TDGs are provided in subsequent chapters.

## **2.3 Theoretical perspectives**

In order to justify the methodologies used in this thesis it is first necessary to discuss the theoretical perspectives and epistemological assumptions that underpinned this work.

Illing defined theoretical perspectives as “the philosophical stances that lie behind the research methodology. They are the starting point from which assumptions about the research are based and they influence how the study is conducted, the researcher’s role and the type of knowledge that is produced” (Illing 2007). A theoretical perspective encompasses ontology, epistemology and methodology (Ritchie and Lewis 2003).

Ontology is the study of being. In a practical context this is often taken to mean the assumptions that a particular theoretical perspective makes about the nature of social reality (Ritchie and Lewis 2003; Illing 2007). Epistemology is the theory of knowledge, its origins and nature, and the limits of knowledge (Ritchie and Lewis 2003; Illing 2007). Epistemology emphasises the nature of the relationship between the researcher and what is to be known. Methodology is the research design or plan that shapes the methods to be used in the study (Ritchie and Lewis 2003; Illing 2007). The methodology provides a rationale for the choice of methods (techniques for data collection) used in a study.

### **2.3.1 Examples of theoretical perspectives**

Many different theoretical perspectives have been described and it is beyond the scope of this thesis to describe each in detail. This section briefly summarises three of the most commonly described theoretical perspectives.

### **2.3.1.1 Positivism**

In positivism the ontology is realism and the epistemology is objectivism (Illing 2007). Positivism maintains that there are facts that can be accurately collected about the social world, which are independent of individual interpretation. It is assumed that the researcher is capable of investigating the object of study without influencing it or being influenced by it. Positivist research usually aims to generate results that can be generalised to a larger population beyond the study sample. For example, although rarely explicitly stated, a randomised controlled trial assumes positivist epistemology.

### **2.3.1.2 Post-positivism**

In post-positivism the ontology is critical realism and the epistemology is objectivist (Illing 2007). Reality is assumed to exist, but unlike positivism reality cannot be truly known. Post-positivism also assumes that the researcher does not influence the study findings and reports them objectively. Post-positivist researchers may take a mixed-methods approach, sometimes applying both quantitative and qualitative approaches. Post-positivist researchers also aim to generate generalisable results.

### **2.3.1.3 Constructivism**

Constructivism is somewhat different from positivism and post-positivism. The ontology of constructivism is relativism; this assumes multiple and sometimes conflicting realities that are socially and experimentally based and dependent on individuals for their form and content (Illing 2007). Constructivism views the role of researcher as inseparable from the research process. The researcher will influence

the data gathered and the interpretation of the findings. The constructivist researcher must be able to demonstrate reflexivity. Reflexivity means sensitivity to the ways in which the researcher and the research process have shaped the collected data, including the role of prior assumptions and experience (Mays and Pope 2000). Indeed, in a constructivist perspective different people may construct meaning in different ways, even in relation to the same phenomenon (Crotty 1998). Constructivists acknowledge the importance of context and do not attempt to produce generalisable results. Nonetheless, findings from constructivist studies may be at least partially transferable beyond the context in which the study was undertaken.

### **2.3.2 Epistemological position**

My motivations for carrying out this research, the aims of the research and my epistemological position were all informed by my professional background, beliefs and assumptions. I have practised clinical medicine for more than 12 years and been a part of clinical teams looking after acutely unwell patients throughout that time. My role in these teams has gradually evolved from the most junior member of the medical team to a senior decision maker and often a team leader. I recognise that my own NTS were underdeveloped when I commenced clinical practice and I continue to witness examples of sub-optimal NTS behaviours in the workplace. I have witnessed junior doctors struggling to manage their workload, work cohesively with peers and seniors and escalate care where appropriate. In essence, I have seen and experienced first-hand the problems described in the literature and summarised in the introduction to this thesis.

I therefore approached this research with a strong motivation to explore potential practical strategies that may in some way help address an important real-world problem. It was, and remains, fundamentally important to me that this research be meaningful in the real world and not a detached academic exercise. I was therefore keen to ensure that any resources developed would be of lasting value, at least in the Edinburgh curriculum, beyond the lifespan of the research.

It was clear to me early on that I could not and indeed should not attempt to separate myself from the research participants. I had experience of being a medical student and also as a junior and more senior doctor with whom students professionally interact. Students' behaviour within any teaching session and data gathered would be uniquely influenced by their experiences to date and their relationships with each other and with me as the researcher. As such, it became clear that my epistemological position throughout this work was of constructivism. Hence, the conclusions drawn are my own interpretation and other researchers may have drawn different conclusions.

## **2.4 Rationale for selecting final year medical students as research participants**

Final year medical students were selected as the participants of these studies for a number of reasons. Firstly, newly qualified doctors assume responsibilities for patient care from the outset of practice. As such, they need to be prepared for practice from day one of clinical practice. To achieve the required level of preparation they therefore require to be adequately trained prior to commencing

practice. That is not to say, however, that they should not receive on-going NTS training after commencing practice and indeed throughout their careers. An element of pragmatism also informed selecting undergraduate students rather than practising doctors. Junior doctors' time is tight, they have a number of conflicting responsibilities and they work a range of shift patterns. As such, it was anticipated that access to the students might be more straightforward than access to junior doctors.

As outlined in Chapter 1, teaching on NTS is introduced from the beginning of training in aviation (Flin and Patey 2009). Why then, focus on final year medical students, rather than students at an earlier stage of the curriculum? This approach was taken for a number of reasons. Again, access played a part. At the time the work of this thesis was undertaken the University of Edinburgh medical curriculum was a five-year integrated systems-based curriculum, with all students undertaking an eight-week single-site general medicine attachment in their final year. This relatively lengthy attachment was thought to be a good opportunity to be able to recruit students for a number of sessions if required. The ethos of this attachment was also important as it placed a strong emphasis on preparation for practice, more so than most other attachments within the curriculum. As such, it was anticipated that students would be motivated to engage in activities that might develop NTS and meaningfully contribute to preparation for practice. Finally, whilst generic TDGs could theoretically be introduced at any point in the curriculum adequate medical knowledge was assumed to be a pre-requisite for exploring the use of domain-

specific medical TDGs. The final year general medicine module was therefore felt to be a particularly good place to explore the use of domain-specific medical TDGs.

## **2.5 Feasibility and acceptability study**

This section provides an overview of the methodology used in the study described in Chapter 3.

As outlined in the introduction, TDGs had been used quite extensively in a wide range of safety-critical industries. Their potential use in undergraduate medicine was intriguing, as they appeared to be cheap to run, certainly cheaper than high-fidelity simulation and could potentially be adapted to use in a variety of contexts. As such, they could potentially be used at various stages in the curriculum. However, their use in acute medical settings was somewhat limited. It could not be assumed that TDGs would be a feasible way of teaching NTS to final year medical students. Generic TDGs had been used in other industries and it seemed pragmatic to explore the feasibility of using already available generic TDGs in the first instance.

I decided to follow generic TDG sessions with acute care simulation scenarios. This served two broad purposes. Firstly, I knew that students would be familiar with acute care simulation scenarios as they are embedded throughout the Edinburgh curriculum. Whilst students would likely be unfamiliar with TDGs they would understand that participation in the study would give them additional acute care simulation scenario experience. To some extent this was a pragmatic ‘carrot’; without voluntary participation I would not get the study off the ground. More



importantly, however, the acute care simulation scenarios would provide a clinical context for students to apply the NTS learned about in the generic TDGs. The development of the acute care simulation scenarios and my training in simulation scenario design and debriefing is described in Chapter 3.

I had no experience of facilitating a TDG prior to undertaking this study so it seemed prudent to pilot sessions with colleagues within the Centre for Medical Education (CME). I trusted that they would provide honest constructive feedback that would inform how I would run scenarios with the students. The pilot sessions are described in more detail in Chapter 3.

How to capture students' perceptions of participating in the generic TDGs and simulation scenarios? I needed a technique that generated data that accurately represented the students' experience and would allow me to construct meaningful interpretation to the data gathered. Grounded theory methodology with focus groups as the method of data collection fulfilled these criteria.

### **2.5.1 Grounded theory**

Glaser and Strauss originally described grounded theory methodology (Glaser and Strauss 1967). Grounded theory is a research methodology that explores social phenomena through the development of theoretical explanations that are grounded in/derived from the practical experience of study participants (Lingard and Kennedy 2007). Glaser applied positivistic methodological training to the development of qualitative data analysis while Strauss' position is considered post-positivist (Illing

2007). Consistent with a positivistic epistemological stance Glaser proposed grounded theory as a technique that enabled theory to be *discovered* from the data.

However, as stated above the epistemological stance underpinning the work in this thesis is constructivism and as such I believed that meaning and theory should be *constructed* rather than discovered from the data. This led me to utilise constructivist grounded theory methodology described by Charmaz (Charmaz 2006).

#### **2.5.1.1 Constructivist grounded theory**

Constructivist grounded theory provides a method for developing theories based in empirical data and attuned to particular contextual orientations (Lingard 2014).

Constructivist grounded theory adopts the inductive, comparative, emergent and open-ended approach of grounded theory described by Glaser and Strauss (Charmaz 2006). Data collection and analysis take place simultaneously in an iterative process. This allows emergent themes to be further explored in subsequent cycles of the process. New data is compared with that already gathered and analysed in a process called constant comparison. Relationships between themes can also be explored in subsequent cycles. Data collection ceases when no new concepts are emerging from the data and theoretical saturation has been achieved (Ritchie and Lewis 2003). Rigour can be added by independent coding by a co-researcher and in some cases by participant validation.

Grounded theory aims to develop a theory or to explain a process, rather than testing or verifying existing theory (Kennedy and Lingard 2006). As such, grounded theory

is a particularly valuable methodology when conducting research that aims to understand topics where there is a paucity of existing literature. For example, Tallentire used a constructivist grounded theory approach when seeking to understand the behaviour of newly qualified doctors in acute care contexts (Tallentire et al. 2011). Tallentire recognised that there were few studies comparing the perceptions of newly qualified and senior doctors in relation to acute care. She then used a constructivist grounded theory approach to explore factors influencing behaviours from perspectives of both junior and senior doctors. Emerging themes were then used to develop a conceptual framework that explained the influences on newly qualified doctors' behaviour in the context of caring for acutely unwell patients.

### **2.5.2 Focus groups**

A variety of methods can be used to gather data in a grounded theory study. Interviews and field observations are probably the most common data sources, but focus groups, policy documents and reflective journals have also been used (Kennedy and Lingard, 2006). Interviews and focus groups both seemed appropriate methods of capturing students' perceptions of participating in the generic TDGs and acute care simulation scenarios. Focus groups are "a form of group interview that capitalises on communication between research participants in order to generate data" (Kitzinger 1995). Focus groups are an effective means of exploring differences between participants and can be used when the group process will itself illuminate the research issue (Ritchie and Lewis 2003). It was therefore envisaged that focus groups would add breadth to data collection as data emerged through

group interaction. Focus groups also facilitate the expression of criticism and the exploration of different types of solution (Kitzinger 1995). Such critique would be important in informing the iterative development of TDG and simulation sessions. There was also an element of pragmatism here: focus groups would enable data to be gathered in a timelier manner than individual interviews.

## **2.6 Developing NTS through TDGs and acute care simulation**

This section provides an overview of the methodology used in the study described in Chapter 4.

Chapter 3 focussed on exploring the feasibility and acceptability of using generic TDGs to explore final year medical students' NTS. The objective of Chapter 4 was to explore if generic TDGs and acute care simulation could be used in a complementary way to develop final year medical students' NTS.

How then to explore how TDGs and acute care simulation could be used together to develop medical students' NTS? There appeared little reason to change the format of the TDG sessions, which are described in detail in Chapter 3. The development of the acute care simulation scenarios is also described in detail in Chapter 3. These sessions had been generally well received with student feedback informing the iterative development of the acute care simulation scenarios. Once again, the challenge was to find a method of data collection that would enable me to construct meaning from the students' experience of the generic TDGs and acute care

simulation sessions. Video-stimulated debrief interviewing (VSDI) fulfilled this criteria.

### **2.6.1 Video-stimulated debrief interviewing (VSDI)**

Stimulated recall involves the use of audiotapes or videotapes of skilled behaviour, which are used to aid a participant's recall of thought processes at the time of that behaviour (Calderhead 1981). It is a particularly useful technique for exploring the tacit thought-processes underpinning behaviour. For example, as a researcher I could observe behaviour in the acute care simulation scenarios, but without probing I could not be sure of the knowledge and attitudes that informed that behaviour. In VSDI, a recorded event is played back to participants, paused at various points and participants are asked to describe their thought-processes and rationale for exhibited behaviours at that point in time. As described in Chapter 3, I had been trained in simulation debriefing. The process of video-stimulated debrief interviewing is described in more detail in Chapter 4.

How to analyse the data gathered through the VSDI? To some extent, I was able to utilise aspects of the grounded theory methodology described above. However, whilst grounded theory starts with open coding and is inductive at the start before becoming both inductive and deductive I felt it may be helpful to start with some pre-defined codes, hence utilising both inductive and deductive analysis from the outset. The VSDI debriefing was strongly informed by Mellanby's behavioural marker system described in Chapter 1 (Mellanby et al. 2014) and as such it seemed prudent for categories from the behavioural marker system to serve as initial codes.

However, I did not want to be restricted to a framework analysis and therefore I also allowed open coding throughout the process. Indeed, the final thematic analysis, described in Chapter 4, is quite different from Mellanby's acute care behavioural marker system.

## **2.7 Developing NTS through medical TDGs**

This section provides an overview of the methodology used in the study described in Chapter 5.

Chapters 3 and 4 explored the role of generic TDGs and acute care simulation as part of a strategy to develop NTS. However, as described in the introduction, other safety-critical industries have used a combination of generic and context-specific TDGs, often in a complementary way as part of NTS-training programmes. I now wished to explore the potential role of acute medical TDGs as a novel method of developing final year medical students' NTS. In particular, I was interested in how learning from medical TDGs may differ from learning from generic TDGs.

The first task was to develop the medical TDGs. Development was informed by the TDG-writing principles described by Schmitt and outlined in Chapter 1 (Schmitt 1996). I was able to draw on my learning from Chapters 3 and 4 and also from my own clinical experiences. I strongly felt it was important to get the product as bespoke as possible prior to running sessions with students. To this end, I consulted several medical and nursing colleagues with an interest in NTS to help refine TDGs that I had drafted before attending an expert-panel meeting with two national experts

in simulation-based education. The expert panel technique uses a structured meeting to gather information from relevant experts about a given issue (Jones and Hunter 1995). For example, expert panels have been used to establish consensus in the development of behavioural marker systems, such as the ANTS and non-technical skills for surgeons (NOTTS) systems (Flin et al. 2010; Yule et al. 2006). The development of the medical TDGs is described in full in Chapter 5.

It should be emphasised that once more my methodology was underpinned by constructivist epistemology. I anticipated that as a senior trainee my relationship with the students would inevitably have a bearing on the running of the sessions and data gathered and that this should be acknowledged and embraced.

I elected to run a single medical TDG session incorporating both games developed with an immediate follow-on focus group to evaluate the students' experiences of participating in the medical TDGs. I did not feel that an acute care simulation session was necessary as I anticipated that the clinical relevance of the sessions would be clearly evident to the students. As in earlier phases, the process was informed by grounded theory methodology with focus groups providing the same benefits as previously outlined.

## **2.8 Conclusions**

This chapter has described the constructivist epistemological perspective underpinning the work presented in this thesis. The aims of respective chapters have been outlined along with a rationale for the methodologies used to answer the

respective research questions. The influence of grounded theory has been particularly acknowledged as it informed work done throughout the thesis. More detailed description of methods employed will be provided in Chapters 3-5 respectively.



# **Chapter 3: exploring the feasibility and acceptability of using generic TDGs as a novel tool to develop NTS**

## **3.1 Introduction**

Chapter 1 defined the key NTS required by Foundation Doctors as decision-making, situation awareness, task management and teamwork (Mellanby et al. 2104). The critical importance of NTS with respect to medical error and patient safety was described along with evidence that Foundation Doctors have difficulties exhibiting effective NTS behaviours. There is evidence from within and beyond healthcare that NTS can be developed through training. There appeared therefore to be a compelling case for the urgent introduction of NTS training into the undergraduate curriculum.

TDGs were presented as a low-cost, low-fidelity easy-to-facilitate potentially sustainable resource that had been used to develop a range of NTS in safety-critical industries. It could not be assumed, however, that they would be a feasible and acceptable way of developing undergraduate medical students' NTS. Medical students do not assume responsibility for patient management until they commence practice as Foundation Doctors, and as such may not have direct experience of requiring effective NTS behaviours. There was therefore some concern that students would not appreciate the importance of NTS and the value of strategies that aimed to develop these skills.

This chapter will describe the process of exploring the feasibility and acceptability of using generic (non-medical) TDGs as a novel tool to develop NTS. It begins with a description of piloting generic TDGs with colleagues from within the University of Edinburgh Centre for Medical Education (CME). Thereafter, follows a detailed description of the process of running generic TDG, acute care simulation and focus group sessions with groups of final year medical students.

### **3.1.1 Ethics**

The University of Edinburgh committee on the use of student volunteers prospectively approved the study described in this chapter.

## **3.2 Chapter aims**

As outlined in Chapter 2 the aim of this study was to explore the feasibility and acceptability of using generic TDGs as a novel tool to develop final year medical students' NTS. More specifically, the study was designed to explore whether and how students learned about NTS through participation in the generic TDG sessions.

## **3.3 Methods**

As described in Chapter 2 this was a grounded theory study underpinned by constructivist epistemology. This section describes the detailed methods/tools of data collection utilised in this study.

### **3.3.1 Piloting**

The first task was to identify suitable generic TDGs that could potentially be used to identify NTS. Selection of suitable TDGs was informed by the principles of good TDGs described by Schmitt (Schmitt 1996). Specifically, in addition to encompassing elements of uncertainty and ambiguity, Schmitt recommended that TDGs should be: interesting, challenging, plausible, accurate, contain the right amount and proper type of detail, allow for multiple interpretations and solutions and have a reasonable time limit (Schmitt 1996).

Two generic TDGs were selected following extensive web searching. They concerned a plane crash and lost at sea exercise respectively and are presented in Figures 12 and 13 respectively.

**Figure 12 – Plane crash generic TDG (used with permission of Dr Catherine**

**Collier)**

You are on your way to somewhere familiar to your team. Your team has crash-landed your cargo-plane in the middle of a barren plain. You only have time to choose to access one cargo hold, either the fore (front) hold or the aft (back) hold. Look at the list of items in each hold and choose just 10 survival items. Assuming that no one is injured, what 10 items will you take out of the plane and which hold will you access?

<b>AFT HOLD</b>	<b>FORE HOLD</b>
1 - A case of hammers	1 - One 1lb bag of raisins
2 – 10lb sack of sugar	2 – One 10' X 10' plastic tarpaulin
3 – A case of nails	3 – One magnifying glass
4 – A crosscut saw	4 – A small metal box of matches
5 – A case of canned beans	5 – A Swiss Army pocket knife
6 – A case of flour	6 – part of The Times newspaper
7 – Six 8 X 4 ft. sheets of plywood	7 – Three 1 qt. canteens of water
8 – A case of screwdrivers	8 – 2 pillow cases
9 – A case of marshmallows	9 – 2 rolls of gauze bandage strips
10 – A stack of 2 X 4's	10 – A coiled rope
11 – A case of can openers	11 – A compass
12 – A case of wrenches	12 – Six granola bars
13 – A case of screws	13 – 3 pairs of boots
14 – A box of paper plates and cups	14 – A bag of marshmallows
15 – A box of 6 down pillows	15 – A scout mess kit
16 – A self-starting acetylene torch and tank	16 – 2 down sleeping bags
17 – 5 gallon barrel of water	17 – 6 bandanas
18 – 2 large canvas tarpaulins	18 – A package of chewing gum
19 – A case of canned fruit	19 – Six oranges
20 – A case of Spam	20 – A box of Crayola crayons
21 – A king size mattress and bedding	21 – A box of toothpicks
22 – A case of neon-coloured Band-Aids	22 – A roll of film
23 – One 200 foot roll of cable/wire	23 – One 1lb bag of lentils
24 – A case of plaster-of-Paris impregnated rolls of gauze	24 – Two plaster-of-Paris impregnated rolls of gauze
25 – A case of Crayola crayons	25 – One small hatchet

**Figure 13 – Lost at sea generic TDG (used under “Fair Use” copyright agreement)**

You and your team have chartered a yacht. None of you have any previous sailing experience and you have hired an experienced skipper and 2-person crew. As you sail through the Southern Pacific Ocean a fire breaks out and much of the yacht and its contents are destroyed. The yacht is slowly sinking. Your location is unclear because vital navigational and radio equipment has been damaged. The yacht skipper and crew have been lost whilst trying to fight the fire. Your best estimate is that you are approximately 1000 miles South West of the nearest landfall. You and your friends have managed to save the following 15 items, undamaged and intact after the fire:

- 1) A sextant (an instrument used to measure the angle between any 2 visible objects)
- 2) A shaving mirror
- 3) A quantity of mosquito netting
- 4) A 5 gallon can of water
- 5) A case of army rations
- 6) Maps of the Pacific Ocean
- 7) A floating sea cushion
- 8) A 2 gallon can of oil/petrol mixture
- 9) A small transistor radio
- 10) 20 square feet of opaque plastic sheeting
- 11) Shark repellent
- 12) One quart of 160% proof rum
- 13) 15 feet nylon rope
- 14) 2 boxes of chocolate bars
- 15) A fishing kit

In addition to the 15 items above, you have salvaged a 4-man rubber life raft. The total of your combined pockets amounts to a packet of cigarettes, three boxes of matches and 3X £5 notes.

**Task: to rank the above 15 items in order of importance to your survival.**

It was felt that both of these scenarios fulfilled the criteria described by Schmitt. In particular, there was no clear single best solution to either scenario and both contained high levels of uncertainty and ambiguity.

Each scenario was piloted in a single session with colleagues from the CME. It was important to allow sufficient time to play and debrief each of the generic TDGs, but also for participants to feedback their experience of participation and suggestions for development prior to running sessions with medical students.

Initially, the plane-crash generic TDG was piloted in a single session with colleagues from the CME. 12 colleagues with a range of professional backgrounds attended. Thereafter, eight CME colleagues attended a lost at sea generic TDG pilot session. Each session lasted for around one hour, including provision of feedback on the session. The professional background of attendance at each of these sessions is summarised in Figures 14 and 15 respectively.

**Figure 14 – Attendees at plane crash generic TDG pilot session**

<b>Attendee</b>	<b>Professional background</b>
1	Director of Clinical Skills and Emergency Medicine Consultant
2	Director of CME and Professor of Medical Education
3	Senior Lecturer in Medical Education and General Practitioner
4	Fellow in Medical Education and Specialty Registrar in Geriatric Medicine
5	Fellow in Medical Education
6	Fellow in Medical Education
7	Fellow in Medical Education
8	Fellow in Medical Education
9	Clinical Skills Facilitator
10	Clinical Skills Facilitator
11	Clinical Skills Facilitator
12	Administrator

**Figure 15 – Attendees at lost at sea generic TDG pilot session**

<b>Attendee</b>	<b>Professional background</b>
1	Director of Undergraduate Learning and Teaching and Consultant Nephrologist
2	Director of Centre for Medical Education
3	Senior Lecturer in Medical Education and General Practitioner
4	Fellow in Medical Education
5	Fellow in Medical Education
6	Fellow in Medical Education
7	Additional Cost of Teaching Officer
8	Administrator

In each session, the groups were randomly divided into two subgroups and presented with the generic TDG scenarios. Both subgroups were then required to come up with a solution to the scenarios in a time-pressured environment. The subgroups were then required to present their respective solutions back to me (the facilitator) and the other subgroup. There then followed a discussion around the NTS required to work effectively in a team in the scenario and how NTS behaviours may have influenced decision-making within the scenarios.

In each session both subgroups came up with different solutions to the presented scenario and this stimulated healthy debate amongst individuals within and between



the groups. Participants were able to recognise NTS being used effectively (and less effectively) in the sessions. Hierarchies present outwith the session appeared to have a bearing on team dynamics within the sessions. For example, senior staff from within the University tended to take on a leadership role within scenarios even if they had no personal experience of managing the kind of situation presented within the scenarios. It was also apparent that less assertive people tended to allow the views of more dominant individuals to prevail and did not always speak up in real-time within the scenarios. These sessions were not audio or video recorded and it could be difficult to observe everything that was going on in real-time. In particular, it was difficult to observe more than one sub-group at a time and provide an appropriate depth of feedback to both groups.

Participants were asked to provide feedback on each of the sessions. Participants reported that the use of non-medical scenarios had created a “safe” environment with no expectation of prior knowledge of the subject matter of the scenarios. Non-medical scenarios may therefore be perceived as less “threatening” by less knowledgeable students. This would be an issue for further exploration with students and would indeed form a part of the initial focus group topic guide.

There was some concern that it would not be obvious to students how NTS used and discussed in the generic TDGs related to the clinical environment. Participants suggested that the importance of NTS in clinical contexts would need to be made explicitly clear in generic TDG sessions. This is discussed further later in this chapter.

There was some concern that a lack of “emotional investment” might influence behaviour within the generic TDG sessions. It was also suggested that the use of the word “game” might contribute to this lack of emotional investment. However, lack of emotional investment had not been reported in any of the TDG literature and similarly the term “tactical decision game” had been widely used without concern.

It was suggested that there might be some value in allowing students the opportunity to observe their colleagues as well as participating directly in TDGs. This may allow them to observe situations where effective and less effective NTS behaviours had been exhibited. This would also allow students the opportunity to provide feedback to their peers. This was an intriguing idea and would also provide a means of avoiding the described difficulties of observing sub-groups simultaneously.

### **3.3.2 Generic TDG sessions with students**

As described in Chapter 2, Year 5 students in the medicine block were selected as participants as they were at a stage in their undergraduate training where they were encouraged to focus on preparation for practice.

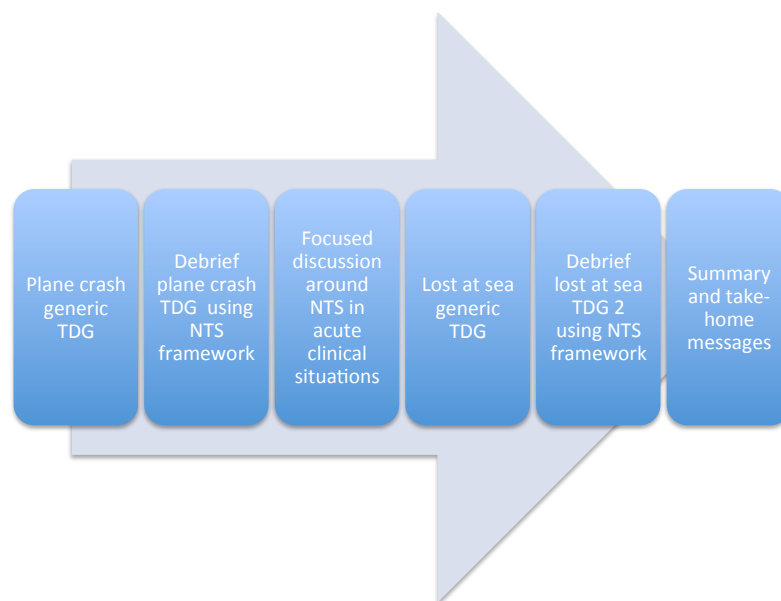
Following piloting, consideration turned to running generic TDG sessions with groups of final year medical students. Two learning points from piloting critically informed the structure of subsequent generic TDG sessions:

- 1) It would not be possible to observe more than one sub-group of students at work simultaneously and provide appropriately detailed feedback.

- 2) The clinical relevance of the NTS used and discussed in the generic TDG sessions would need to be made explicitly clear to students.

These maxims underpinned the structure of the generic TDG sessions presented in Figure 16.

**Figure 16 – Structure of generic TDG session with students**



Mellanby's acute care behavioural marker system was used as a framework for debriefing each of the TDGs to ensure that debriefing focussed on key Foundation doctors' NTS (Mellanby et al. 2014).

The focussed discussion around TDGs would be key to enabling students to recognise the importance of NTS in clinical contexts. In order to emphasise the role of NTS an audio clip of a junior doctor describing her experience of looking after a critically unwell patient was used to facilitate discussion. This audio clip was borrowed with permission from one of the critical incident interviews that led to the development of Mellanby's behavioural marker system (Mellanby et al. 2014).

Potentially eligible students were approached both by email and in person. 38 students undertaking general medicine attachments provided written consent and voluntarily participated in a generic TDG session in four groups of between eight and 13 students respectively. The composition of groups for each of the sessions is presented in Figure 17.

**Figure 17 – Number of students attending generic TDG session**

<b>Generic TDG session</b>	<b>Number of participating students</b>
1	13
2	8
3	8
4	9

Each session lasted between 75 and 90 minutes. Given the group sizes and for reasons previously described, within each session, students were randomly allocated into two groups with all students directly participating in a TDG and observing their peers participating in another TDG. Observing students were also encouraged to

provide feedback to actively participating students. All sessions were video-recorded and field notes made whilst watching back the video recordings.

### **3.3.3 Acute care simulation scenarios**

Prior to conducting this research I had experience of participating in acute care simulation scenarios but not of designing scenarios and running sessions. I attended the Scottish Centre for Simulation and Clinical Human Factors Introduction to Simulation Faculty Development course. On this course I learned principles of scenario design and how to give structured feedback following simulation scenarios.

As previously outlined, the main purpose of the acute care simulation scenarios was to give students the opportunity to apply the NTS learned about in the generic TDGs in a clinical context. The emphasis of the work described in this chapter was to explore the feasibility of using generic TDGs to develop NTS. As such, the acute care simulation scenarios did not need to be perfect at the start. Indeed, this study would serve to enable the iterative development of the acute care simulation scenarios into a product that would be suitable for the work described in Chapter 4.

It was important that scenarios should reflect common clinical situations faced by newly qualified doctors. Scenarios needed to be written with an appropriate balance of medical complexity. For example, students needed to know enough about pulmonary oedema or debriefing would potentially become focussed on medical knowledge rather than NTS. Equally, scenarios needed to be of sufficient complexity for students to be challenged and require them to exhibit effective NTS

behaviours. It was also important that scenarios reflected the uncertainty and ambiguity of the clinical world. In essence, the principles of good TDG writing described by Schmitt also applied to acute care simulation scenario design (Schmitt 1996).

Scenarios involving post-operative sepsis, acute pulmonary oedema and a gastrointestinal bleed were selected, as they are examples of common clinical situations faced by Foundation doctors. I wrote the scenarios myself and then edited them in collaboration with the NHS Fife Clinical Skills Facilitator. An example scenario presented to students is shown in Figure 18.

**Figure 18 – Student brief for sepsis scenario**

Location: You are the FY1 on call at night in the surgical ward of a small district general hospital. Senior help is the surgical middle-grade doctor who is available by phone.

Patient: Andrew Jones is a 65-year-old man who was admitted electively 2 days ago for a cholecystectomy. An open cholecystectomy was performed. You have been called to the ward because Mr Jones has been complaining of increasing shortness of breath. A ward nurse is in attendance.

Following the TDG session, 29 of 38 students participated in a high-fidelity acute care simulation scenario session that involved the application of NTS in a clinical context. A total of five simulation sessions each containing three scenarios were run. Students attended in groups of between two and 10 students. The composition of groups for each of the sessions is presented in Figure 19.

**Figure 19 – Numbers of students attending acute care simulation scenario sessions**

<b>Acute care simulation session</b>	<b>Number of participating students</b>
1	10
2	2
3	7
4	5
5	5

The variability in the number of students attending each session reflected the need to be pragmatic. Students had a range of other commitments including night shifts and this led to a disparity in the numbers amongst sessions, and also contributed to some students who attended generic TDG sessions being unable to attend an acute care simulation session.

All participating students had the opportunity to actively participate in and observe at least one scenario. Each simulation session lasted between 105 and 135 minutes. I debriefed all of the simulation sessions using the NTS framework as a point of reference for the simulation debriefing (Mellanby et al. 2014). The acute care simulation session was also video-recorded to allow analysis of students' NTS behaviour.

Consistent with the constructivist approach underpinning this work, the acute care simulation scenario sessions evolved and developed in response to feedback from

students. For example, acute care simulation sessions did not initially begin with an NTS recap. However, given that there was sometimes a delay of several days between the generic TDG session and the acute care simulation session, students suggested that an NTS recap at the beginning of the acute care simulation session would be worthwhile. This involved re-presenting the NTS framework (Mellanby et al. 2014) and keeping the framework visible to students throughout the sessions. Explicitly linking the debriefing to the NTS framework also helped reinforce NTS concepts.

Additionally, in response to student feedback scenarios were adapted so that they were slightly less acute in nature. Students reported that they felt overwhelmed by medical aspects of very acutely unwell patient scenarios and felt better able to focus on NTS in more sub-acute scenarios. It also proved feasible to incorporate increasing levels of uncertainty and ambiguity in more sub-acute scenarios, consistent with the objectives of the session.

### **3.3.4 Focus groups**

The rationale for selecting focus groups for data collection has been described in Chapter 2. In particular, focus groups encourage participants to critique colleagues' ideas and opinions (Kitzinger 1995). In preparation, I attended a workshop on running focus groups at an Association for the Study of Medical Education (ASME) Researching Medical Education conference.



I elected to conduct all of the focus groups myself. I felt this was critical, given that the findings would essentially be my own interpretation, consistent with constructivist epistemology. Specifically, the data gathered would attach meaning to experiences that I had shared with the research participants. The initial focus group topic guide, informed by the research question, literature review and piloting is presented in Figure 20.

## **Figure 20 – Generic TDG feasibility study initial topic guide**

### **Introduction**

Thank people for attending the component parts of the study. Explain purpose of this session is to discuss their experience of participating in the tactical decision game (TDG) sessions to facilitate further development of the TDGs. Emphasise that the underlying purpose of the study is to determine the role of TDGs as a method of teaching non-technical (NTS) to final year medical students.

Remind participants that session is being recorded and that whilst they may be quoted in educational research no comments or opinions will be attributed to them personally.

Opportunity for questions

### **Initial Questions**

What were your key impressions of participating in the TDG sessions?

How did you find the use of generic/non-medical TDGs? Might the sessions have run differently using medical TDGs?

What were your impressions of the format of the sessions?

*Include group size/length of session/assigning roles/active and passive participation/feedback to participants/role of simulation scenario/time between sessions*

Were any aspects of the TDG sessions particularly challenging?

What learning points do you think you took away from the TDG sessions?

Did participating in the TDG sessions influence your behaviour in the acute care simulation session?

What changes would you consider if further developing the TDG or acute care simulation sessions?

### **Close**

Thank everyone for participation

Participants can view/listen to recordings or view transcripts if they wish

Further opportunity for questions

Establish if participants willing to be contacted after starting work as an FY1

### **Notes**

Get everyone to introduce themselves at the start to facilitate transcription

Aim to get everyone to contribute

Encourage participants to comment on the views of others in the group

28 students participated in a focus group, with the remaining students again unable to attend mainly due to scheduling conflicts, for example rotating onto night shifts. A total of five focus groups, each comprising between four and seven students and lasting between 60 and 90 minutes, were undertaken. The composition of each of the focus groups is presented in Figure 21.

**Figure 21 – Numbers of students attending focus group sessions**

<b>Focus group</b>	<b>Number of participating students</b>
1	4
2	6
3	7
4	5
5	6

The focus groups were audio-recorded and transcribed verbatim.

### **3.3.5 Data analysis**

As described in Chapter 2 this work was underpinned by constructivist grounded theory methodology. Initially, I listened back to all of the focus group sessions within a day or two of conducting the sessions. This contributed to reshaping aspects of the acute care simulation scenarios but also to the iterative development of the focus group topic guide, enabling emerging areas of interest to be explored in greater depth in subsequent focus groups. For example, as uncertainty and ambiguity emerged as a potential theme it was added to the focus group topic guide.

Transcribed data was subsequently thematically analysed using NVivo Version 10 (QSR International Pty Ltd, Doncaster, Vic, Australia) software (Bazeley and Jackson 2013). I would emphasise that I used NVivo to organise the data rather than to assist with data analysis per se. Initially, I performed “line by line coding” to make sense of students’ comments as per grounded theory methodology (Charmaz 2006). Thereafter, the data was inductively (and subsequently deductively) coded into areas of overlapping interest, until emergent themes begun to develop.

Rigour was added by the independent coding of the data by an independent researcher (GS). GS was a Year 4 medical student at the time of the study. I recognised that she was at a stage of training very close to the participants and as such she would approach the data from a complementary perspective. Themes identified by GS were compared with those that I had identified, enabling triangulation of themes. Where differences in themes were identified these differences were discussed and resolved until consensus was achieved.

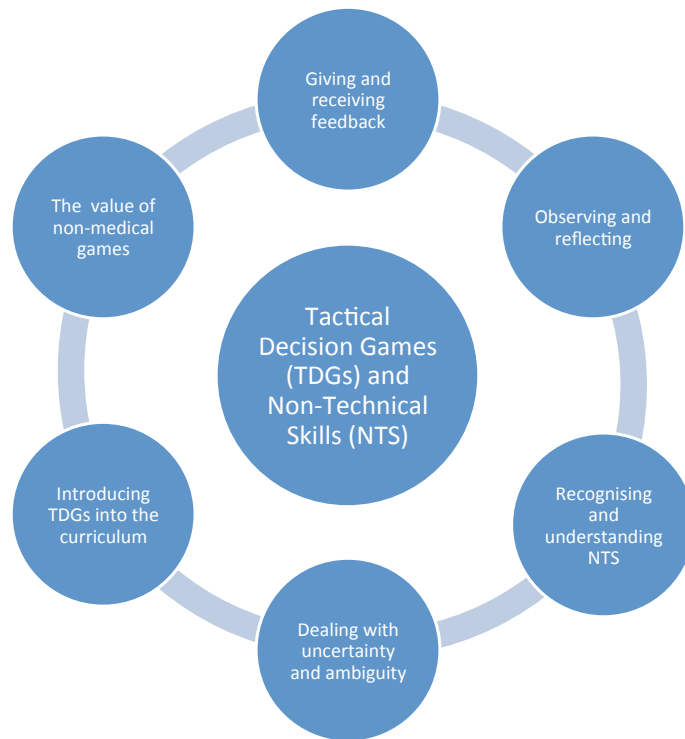
### **3.4 Results**

As stated previously, the main objective of the study described in this chapter was to explore the feasibility and acceptability of using generic TDGs as a novel tool to develop NTS in final year medical students.

With respect to this research question, six key themes emerged from the data: “the value of non-medical games”; “giving and receiving feedback”; “observing and reflecting”; “recognising and understanding NTS”; “dealing with uncertainty and

ambiguity” and “introducing TDGs into the curriculum”. The themes are displayed in Figure 22.

**Figure 22 – Diagrammatic representation of themes**



### **3.4.1 Value of non-medical games**

Students valued being able to focus on NTS, whilst also appreciating that non-medical games did not make them feel that their medical knowledge was being compared with their peers’:

*“Yeah it’s just assessing one thing, the NTS, it’s not assessing your clinical knowledge; it’s putting everyone on a level playing field.”*

*“Cut away the clinical aspect of it, and everybody’s on the level playing field which everyone has alluded to, the opportunity is there for the people who might know less*

*clinically, to develop the NTS that they may not be able to do in the clinical simulation. So this is definitely a very positive thing.”*

### **3.4.2 Giving and receiving feedback**

Students recognised that feedback received within the TDGs represented a key aspect of the learning from the activity:

*“It wouldn’t be worth doing it without the feedback; the feedback is vitally important and it made you aware of things that you wouldn’t necessarily have thought...or realised had happened.”*

As well as receiving feedback from the facilitator, students also valued the opportunity to give and receive feedback from their peers:

*“With the feedback as well I think even the process of us giving each other feedback is a really important learning step, like being able to feedback appropriately and confidently without worrying you are going to upset someone, or say it wrong, and that’s a really important skill to learn when you are going to be a doctor.”*

Students recognised that giving negative feedback can be particularly challenging, but that this is an essential skill in clinical practice:

*“Even though it is difficult to feedback to someone who didn’t really say anything it’s something we need to be able to do and it’s probably something no-one feels confident of doing, but it would be really helpful.”*

### **3.4.3 Observing and reflecting**

Sessions gave participants the opportunity to actively participate in a TDG and to have the opportunity to observe their peers participating. Students valued observing their peers and relating the behaviour they observed to their own behaviour:

*“It is interesting being on the other side as well and watching other people do it and thinking ‘Do I do this?’ and ‘Oh that’s an interesting way of doing it’ and just watching someone else’s teamwork.”*

TDGs also appeared to encourage students to engage in the process of reflection:

*“It definitely made me think more about why did I think that and why did I react in that way as I don’t really do that often and so it’s quite good at making you reflective without being ‘sigh, argh it’s reflection!’”*

*“It’s only afterwards when you have that framework in front of you and you have to go through it I think it is possible to pick out certain things that you maybe need to work on and think about in the future.”*

### **3.4.4 Recognising and understanding NTS**

The generic TDG sessions appeared to introduce concepts that were unfamiliar to students:

*“I didn’t even know what NTS were. So it was useful just being made aware of what each of them were.”*

In order to influence students’ NTS behaviours it is first necessary for them to develop an awareness and understanding of NTS. Students were able to identify NTS that were required when participating in the TDGs and how NTS behaviours impacted the outcome of the task:

Teamwork: *“The sort of sinking ship...was quite interesting and quite different from other stuff we’ve done and that really did force you to kind of work as a team and put some of these NTS into play.”*

Decision making and reasoning: *“I think, again maybe it was just my mind-set, but I think it really played into reasoning for me, because we had just had a session with someone else talking about not just doing something because you’ve been told to do something but try to reason like ‘why, why, why, why, why’, and I think that was quite good at getting me to think to myself ‘why?’”*

*“I mean it’s difficult to say at the end of the day what would have been the correct choice, but it is how they come to that decision that I think is important.”*

Prioritisation: *“The second [TDG] was about ranking 10 things and that was a bit different, and I thought that was maybe more applicable because if you think about managing a patient, [it is a] bit like A, B, C, D and you know.”*

Speaking-up: *“It’s a non-clinical scenario...but it does make people think ‘oh maybe I should have said something’.”*

Students recognised that awareness of NTS may in turn impact conscious application of NTS in clinical contexts:

*“But I think making you aware of these skills would actually help you develop them...once you are aware you can think I don’t usually act in this way...then you can apply it to yourself.”*

### **3.4.5 Dealing with uncertainty and ambiguity**

Practising clinical medicine often requires working in conditions of uncertainty with missing information and ill-defined goals. TDG scenarios are intentionally ambiguous and missing key information, aiming to increase participants’ need to rely on NTS. Students appreciated the value of raising awareness of uncertainty through the TDGs:

*“I quite liked [the ambiguity and uncertainty]. You had to work out in your team...in what sort of situation do we find ourselves? What are our priorities?”*

Students recognised that this uncertainty reflected real-life in the clinical environment:

*“In clinical practice you might have a patient that you are unsure what’s wrong with them, unsure what to do and there may be differences of opinion of what the best course of action is, but there are several pathways that are clearly inappropriate.”*

*“Dealing with the ambiguity of doubting yourself, doubting your own knowledge; that’s something that’s always going to be there. It’s an important part of why teams do or don’t go wrong.”*

*“I think it’s very good but then ambiguity, I mean from a scientific background, you are often like ‘this is the way things are, things are either right or wrong’... but I think we very rarely think ‘oh there might not quite be a right, or we don’t know the right answer now’. I just don’t think it’s on our minds...”*



### 3.4.6 Introducing TDGs into the curriculum

TDGs are often introduced early in the training curriculum in other safety-critical industries. Students also favoured introducing TDGs and NTS training earlier into the medical curriculum:

*“And it should be something that is started from Year 1 or Year 2 when you do not have so much medical knowledge so you actually stop medicalising things and develop...NTS.”*

Problem based learning (PBL) was suggested as a potential environment for introducing TDGs and NTS training earlier in the curriculum:

*“I think you could integrate something like this more into the curriculum like PBL and in first year you could integrate the games so that people aren’t just learning kind of medical stuff in PBL alone but teamwork skills and NTS.”*

However, support for earlier introduction into the curriculum was not universal and students questioned whether pre-clinical students would appreciate the value of the activity:

*“You may have something like this in year one, like PBL [problem based learning], and [they will] hate it because they will not realise the importance of it.”*

Students recognised that in later years focus moves towards preparation for practice and this change in focus may increase engagement with activities geared towards developing NTS:

*“I think fourth and fifth years are the time we start thinking about being a doctor rather than passing exams...I think fifth year is a good time.”*

It was suggested that longitudinal development and consolidation might aid the development of NTS over time:

*“But then I was thinking that maybe even doing one game isn’t enough, so I was maybe considering like a day of doing tactical games, progressing it, and then doing other games and then seeing the development in progress.”*

### 3.4.7 TDG participation and subsequent NTS behaviour

Application of NTS in the acute care simulation scenarios was also discussed in the focus groups. Although students were able to recognise the importance of NTS they expressed mixed views about whether the experience of participating in the TDGs influenced their behaviour in the simulation scenarios. They appeared to find it difficult to focus on NTS, largely due to feeling overwhelmed by the medical issues within the scenarios:

*“I think it was a difficult jump from the games, which were completely non-medical, to the scenarios, which were very medical because as you know as a medical student, we get wrapped up in the medical details.”*

*“When we did the acute care scenario, and maybe because it’s only two months till finals, I was thinking of making sure I did the ABG and I knew how to do this, that, and the other...”*

*“Because you are managing the patient in the acute clinical scenario there wasn’t the time to actually make a decision based on the NTS that we learned. I mean you are so wrapped up in the clinical scenario that you can’t make those conscious decisions and I think when you are trying to learn a new skill you do have to consciously think about it for a while before it becomes unconscious.”*

*“That’s why I thought of having the scenario a little bit less acute would have given you the opportunity to think about some of those things, but because I was just simply reacting to a clinical scenario in front of me I couldn’t tell you if I did or not [apply NTS learning].”*

## 3.5 Discussion

This feasibility study found that TDGs represented a low-fidelity method of teaching NTS that was accepted and valued by students. The use of non-medical TDGs encouraged students to focus on NTS without being distracted by medical issues. Other industries have used generic TDGs to introduce the concept of NTS and then domain-specific TDGs to allow participants to experience making decisions in context (Crichton et al. 2000; Crichton 2009). This study used only non-medical

TDGs; at this stage the use of domain-specific medical TDGs remained to be explored.

Generic TDGs provided a highly valued way of providing students with formative feedback from both facilitators and peers. Student surveys show that feedback is all too often inadequate or absent in teacher-learner interactions (Cantillon and Sargeant 2008). The generic TDGs also provided students with the opportunity to give feedback to their peers. Peer feedback has been shown to promote student involvement in the learning activity (Dochy et al. 1999). There is also evidence that peer feedback enhances student learning, as students are actively engaged in describing their evolving understanding of topics of study (Liu and Carless 2006). Students may find it difficult to give constructive feedback to their peers, but the lack of medical knowledge required in the generic TDG scenarios might have made this less intimidating for some students.

Generic TDGs also encouraged students to reflect on their behaviours within the activity. Reflection encourages learners to connect and integrate new learning to existing knowledge and skills (Mann et al. 2009). There is also growing evidence that reflection improves learning and performance in essential competencies (Aronson 2011). In particular, reflective learning can improve clinical reasoning and management of complex patients and health systems (Aronson 2011). It is important for doctors at the point of graduation to be able to view their practice through a reflective lens. For example, in Tomorrow's Doctors the GMC encourage junior doctors to "continually and systematically reflect on practice and, whenever

necessary, translate that reflection into action” (GMC 2009). It is valuable to instil the habit of reflection in the undergraduate curriculum, as students will be expected to reflect throughout their subsequent medical careers. However, despite the importance of reflection, medical students often find it difficult to engage with the process of reflection (Sandars 2009). This is often due to a failure to integrate reflection within an overall teaching and learning approach (Sandars 2009). Generic TDGs appeared to overcome this difficulty.

Working through the TDGs gave students the opportunity to experience decision-making in situations of uncertainty. Writing in *Nature*, Pullium et al also recognised this strength of TDGs, commenting that “too many training programmes look for responses guided by standard operating procedures with predetermined ‘correct’ answers” (Pullium et al. 2014). Conversely, TDGs require participants to make choices with incomplete information and without clearly ‘correct’ answers. To some extent, it is the process of making a decision that is essential rather than finding the ‘correct’ answer. This is similar to the practice of clinical medicine where patients often present with a complex constellation of symptoms and without a clearly defined diagnosis. In these situations, decisions about treatment must be made despite diagnostic uncertainty.

Generic TDGs appeared to raise awareness and understanding of NTS, though whether this awareness is retained over time remained undetermined. Whether and how TDG participation may influence subsequent NTS behaviour in other contexts such as real-life clinical settings also remained to be determined. It was also not

clear how generic TDGs could be used in combination with other NTS training methods to develop NTS.

### **3.5.1 Limitations**

Participation in this study was entirely voluntary and it could not be assumed that the views of participating students were representative of the wider student group.

Students who elected not to participate may have engaged less well with the activity had it been a core part of the curriculum. Although all students contributed meaningfully to focus group discussion, there is a risk that some students may have been influenced by the views of dominant group members and would have expressed different views in an individual interview setting (Ritchie and Lewis 2003). It is also possible that students who participated in the TDG sessions but did not attend a focus group may have expressed different views. In addition, this is a single centre study and transferability of findings to other contexts cannot be assumed.

## **3.6 Conclusion**

This was the first study to explore the feasibility and acceptability of using TDGs to develop medical students' NTS. At this point, TDGs appeared to represent an exciting potential method of teaching NTS to medical students. They were an easy-to-use, low-fidelity activity that was highly valued by participating students.

Students recognised and appreciated the benefits of using generic (non-medical) scenarios. They provided opportunities to give and receive feedback and stimulated reflection. Participation appeared to develop awareness and understanding of NTS. Students appreciated and valued uncertainty and ambiguity within the scenarios. It

was clear, however, that further studies were required to explore the transfer of learning from TDGs to other contexts and how generic TDGs could be used as part of a wider strategy to develop NTS. The role of context-specific medical TDGs as part of that strategy remained an intriguing possibility.

## **Chapter 4: Developing NTS through generic TDGs and acute care simulation**

### **4.1 Introduction**

Chapter 3 found generic (non-medical) TDGs to be a feasible and acceptable way of teaching final year medical students about NTS (Drummond et al. 2016). Whilst generic TDGs appeared to raise awareness and understanding of NTS, it was not clear to what extent, if at all, this learning would transfer into more clinical contexts. It was also unclear how generic TDGs may complement existing strategies to develop NTS. In Chapter 3, acute care simulation scenarios were used to provide students with a clinical context in which to apply NTS, but focus group data analysis had mainly focussed on NTS development through participation in the generic TDGs.

CRM training in other safety-critical industries has used a combination of learning methods to develop NTS. High-fidelity simulation scenarios are one such technique that has been widely used. It was uncertain whether NTS development through high-fidelity simulation would differ from that via generic TDGs. This study explored if generic TDGs and acute care simulation could be used in a complementary way to develop medical students' NTS.

This chapter will describe the process of running generic TDGs followed by acute care simulation scenarios with video stimulated debrief interviewing (VSDI).

### **4.1.1 Ethics**

The University of Edinburgh committee on the use of student volunteers prospectively approved the study described in this chapter.

## **4.2 Chapter aims**

The aim of this study was to explore if generic TDGs and acute care simulation could be used in a complementary way to develop medical students' NTS. More specifically, the study was designed to explore whether and how key concepts such as uncertainty introduced in generic TDGs would be reinforced through acute care simulation scenarios.

## **4.3 Methods**

The theoretical perspectives and methodology underpinning the work in this chapter have been described in detail in Chapter 2. This is a qualitative study underpinned by constructivist epistemology. Whilst some aspects of grounded theory informed the design and data analysis, this could not be described as a grounded theory study due to the use of some predefined codes informing data analysis. These pre-defined codes were categories from Mellanby's NTS behavioural marker system and were selected as the marker system had critically informed simulation scenario design and debriefing (Mellanby et al. 2014). Nonetheless, the study aimed to develop an explanation for the students' experiences that was grounded in data gathered. This section will describe the detailed methods employed to answer the research question outlined in section 4.2.



#### **4.3.1 Piloting simulation scenarios with VSDI**

The acute care simulation scenarios that had been iteratively developed in response to student feedback in Chapter 3 were used in this study. A pilot acute care simulation session was run with a group of four final year medical students in order to gain experience of VSDI. These students had not participated in a generic TDG session and were not familiar with the NTS framework. The session lasted around two hours. Two acute care simulation scenarios with two students participating and two observing each scenario were run. All four students contributed to the VSDI following both scenarios. Student feedback was favourable, although it was notable that the students were unfamiliar with the NTS framework. This suggested that it would be useful for students to have a printed copy of the NTS to access during the VSDI interviews.

#### **4.3.2 Generic TDG sessions with students**

In this study, a total of 17 students participated in a generic TDG session in a total of three groups each containing between four and seven students. Sessions followed the same structure as described in Chapter 3. The composition of groups for each of the sessions is presented in Figure 23.

**Figure 23 – Number of students attending generic TDG session**

<b>Generic TDG session</b>	<b>Number of participating students</b>
1	7
2	4
3	6

In sessions one and three students were divided into two subgroups and each subgroup participated in and observed a generic TDG scenario. In session two, due to the smaller group size all students actively participated in both generic TDG scenarios. This was a pragmatic decision due to concerns that dividing the group into subgroups of two students would create subgroups too small to bring out team dynamics. Students were given a copy of the acute care behavioural marker system to take away at the end of the session to reinforce key NTS that would be applied in the acute care simulation scenarios (Mellanby et al. 2014). The NTS framework is presented again in Figure 24.

**Figure 24 – Behavioural marker system for junior doctors in acute care**

Category	Element
Situational awareness	Gathering information Recognising and understanding Projection to future states
Decision making	Generating options Balancing options Reviewing of decisions
Task management	Prioritising (tasks and patients) Maintaining standards Being prepared Utilising resources
Teamwork	Speaking up Establishing shared understanding Establishing a team

### **4.3.3 Acute care simulation scenarios with VSDI**

Following the generic TDG session, 16 of the 17 students participated in an acute care simulation scenario that involved the application of NTS in a clinical context.

The scenarios concerned post-operative sepsis, acute pulmonary oedema and an acutely confused patient. The acute care simulation session took place within one week of the generic TDG session. A total of four simulation sessions were run each with groups of between two and six students. The composition of groups for each of the sessions is presented in Figure 25.

**Figure 25 – Numbers of students attending acute care simulation scenario sessions**

Acute care simulation session	Number of participating students
1	2
2	6
3	2
4	6

Once again, the variability in the number of students attending each session reflected the need to be pragmatic. Students had a range of other commitments including night shifts and this led to a disparity in the numbers amongst sessions, and also contributed to one student who attended a generic TDG session being unable to attend an acute care simulation session.

As described in Chapter 2, VSDI was used to explore students' real time and early reflective understanding of their NTS behaviours within the scenarios (Calderhead 1981). I conducted all interviews myself, enabling me to question students on observed and tacit NTS behaviours in the simulation scenarios. Two interviews were performed per session, meaning that a total of eight VSDIs were carried out. Observing students also contributed to the VSDI in four of the eight interviews (from the groups with six students). These students provided a complementary perspective in two subtly different ways. They contributed their own real-time and early

reflective observations of observed NTS behaviours, but also contributed to probing the thought processes of the directly participating students.

Whilst the scenarios were primarily recorded to enable VSDI, the video recording also enabled me to watch the scenarios again afterwards, allowing me to further analyse students' NTS behaviour and to inform questioning for subsequent interviews. The VSDIs were all audio-recorded. I listened back to the VSDIs within a few days of each interview, making field notes. This process also informed questioning in subsequent interviews.

#### **4.3.4 Data analysis**

NVivo Version 10 (QSR International Pty Ltd, Doncaster, Vic, Australia) software was used to organise the data. As in Chapter 3, NVivo was used to organise the data rather than to assist with data analysis per se.

As described in Chapter 2, this study was also informed to some extent by grounded theory methodology. However, given that the acute care simulation sessions and debrief were strongly informed by the NTS behavioural marker system (Mellanby et al. 2014) I felt it would be helpful to include components of the behavioural marker system as initial coding categories. I was, however, open-minded to new concepts emerging and as such I also allowed for open coding throughout the process. Indeed, many fragments of text were coded both under components of the behavioural marker system and under new codes. This process enabled data to be coded both

inductively and deductively into areas of overlapping interest, until emergent themes begun to develop.

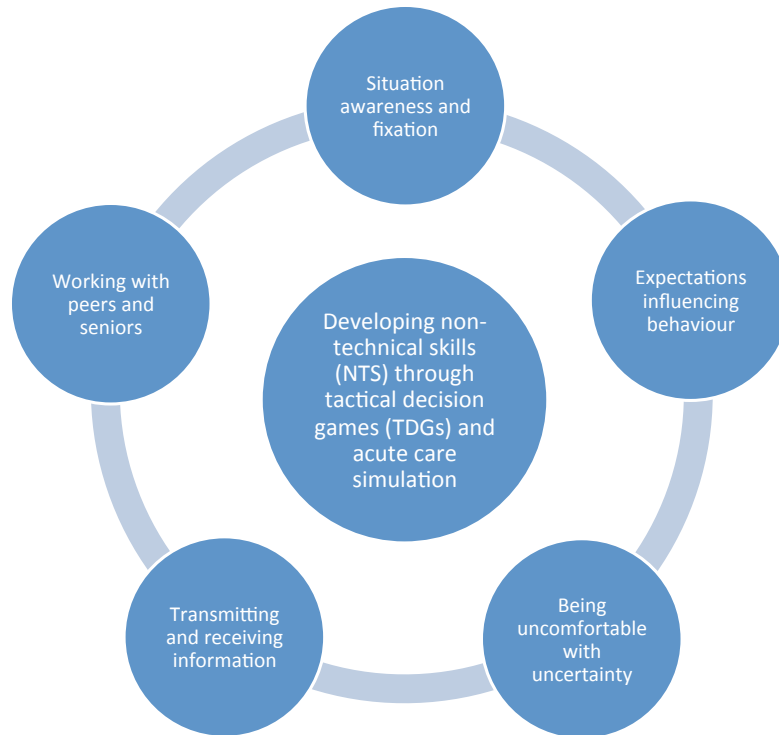
As in Chapter 3, rigour was added by the independent coding of the data by an independent researcher (TL). TL is a trained psychologist and the study gained from the complementary perspective her professional background would provide to data analysis. Themes identified by TL were compared with those that I had identified, enabling triangulation of themes. Where differences in themes were identified these differences were discussed and resolved until consensus was achieved.

## **4.4 Results**

As stated previously, the main objective of the study described in this chapter was to explore how generic TDGs and acute care simulation could be used together to develop medical students' NTS.

With respect to this research question, five key themes emerged from the data: “situation awareness and fixation”; “expectations influencing behaviour”; “being uncomfortable with uncertainty”; “transmitting and receiving information” and “working with peers and seniors”. The themes are displayed in Figure 26.

**Figure 26 – Diagrammatic representation of themes**



#### **4.4.1 Situation awareness and fixation**

Students were able to identify in retrospect instances where situation awareness had been lost:

*“I got sucked in a bit too easily and actually maybe that oversight of being too hands on and involved, reduced the kind of situation awareness overall as I was kind of trying to do the assessment as well as talk to everyone and there were potentially enough of us for someone to step back a little bit.”*

Students appeared to find it easier to maintain situation awareness when observing their peers than when they were actively participating within a scenario:

*“Was this when we said it’s good that they’re administering treatment but shouldn’t they phone for help now?”*

Students recognised that all members of the team had a responsibility to maintain situation awareness within the task:

*And I think it was fault on both of our parts ‘cause I should have been more aware of what he was thinking, but maybe if he had said ‘do you want to come and look at this at some point?’ then maybe I would have come over....”*

Students were able to recognise situations when they had lost situation awareness due to fixation on particular aspects of a task:

*“I think it was quite a good scenario to watch back, and I think it’s good to watch the clip fully as I think it’s the first time – cause they always talk about how you get absorbed in tasks and you think yeah I probably do, but I think actually watching it and realising what you’ve not heard, and I think it’s not until you watch the whole clip back that you realise you just didn’t hear that the first time, or didn’t realise it was said.”*

Students recognised that they were vulnerable to cognitive biases when fixated on a task:

*“I think it was because I was just quite fixated on this, like I’d seen the ECG and just had this uncertainty of what was going on, I didn’t want it to be the bad situation, I didn’t want it to be a STEMI so in my head I was thinking it’s probably an NSTEMI so I was just trying to fit things towards that rather than being a bit more objective in thinking about things I think.”*

#### **4.4.2 Expectations influencing behaviour**

Students felt that there was an expectation that certain tasks should be completed before seeking senior help. This could lead to a delay in seeking senior help:

*“I think at that point I was thinking ‘this is kind of beyond FYI level’ whereas I suppose something else was holding me back picking up the phone, the point was we hadn’t got all the information yet, we haven’t completed our assessment yet, the reg is going to ask what I’ve done and what the information is.”*

*“Yeah and so I was worried about her renal function... before we considered administering a course of antibiotics we wanted to know what her renal function was*



*like. I felt like before we spoke to someone we wanted to have at least have achieved that...”*

Students were also able to identify situations where their expectations of the task may have influenced their behaviour within the task:

*“We did maybe dive in, we could have maybe just taken a moment to collect the notes again and just go over it again, but it was an acute situation so we thought it would be a bit better to just have a look more quickly....”*

*“I think maybe what you said having one person go up and then maybe thinking more laterally about the issues of like she doesn’t want the mask on, so what are the alternatives like we didn’t really get there for a long time. I think we were very stuck in this idea that we were doing something in particular and that’s what we were supposed to be doing.”*

#### **4.4.3 Being uncomfortable with uncertainty**

Students recognised that they felt uncomfortable in situations when they did not know what was going on and this could have a negative impact on their management of the task:

*“And yeah I just felt at this point that okay, the patient is a bit unwell, quite breathless but, I didn’t feel like I could phone anyone as I didn’t know what I was going to pass on about this person, so I felt a bit in limbo – it’s not clear what’s going on, he is sick but I wouldn’t have felt comfortable phoning up a med reg and saying ‘I’ve got a patient who is breathless’.”*

*“I felt like we needed to call for help, but didn’t know what we were calling for help about really, which is why the decision took longer than it should have done, as I was like ‘should we call for help?’ and it was like yeah we will call for help, and then it was ‘well what am I gonna say?’”*

Students felt that they lacked experience of managing uncertain situations:

*“I think we are just really taught to, like in exams and things like that where it is right and wrong and like ‘do this and don’t do this’ and we don’t actually have much experience of like I am not really sure what do I do.”*

#### 4.4.4 Transmitting and receiving information

Students recognised the benefits of establishing and maintaining a shared understanding of the situation with their colleagues and their ability to do this improved with experience:

*“Well I think what we probably did differently here is we vocalised our thoughts a lot more and we tried to stay on the same page a lot more as well...so I think that worked a lot better this time.”*

*“I thought it was a lot easier watching, as going in it was very clear information gathering – there was a good phase of that going on, everyone knew it, everyone went in on the same page. Their approaches were a bit different in that everyone kind of cycled in each role and I suppose the communication and active listening facilitated you being able to do that a bit more, and so that was a good aspect of it.”*

*“I think we were considerably better, I think just about every stage we kind of knew what was going through each other’s minds and we kind of stated what we were trying to achieve which was good.”*

Students would alter their appraisal of a situation based on their colleagues’ shared viewpoint:

*“I guess we are communicating quite well - we are both trying to make sure that we both make each other heard in what we are saying, she was really good at giving her thoughts of ‘is this infection?’ ...And then, so that then went against my idea of the pneumothorax, and I then reassessed it and in that moment I thought this is actually quite reasonable so probably yes...So yes I think just communicating and sort of making sure that we were on the same page in that instance.”*

Students were able to identify situations in retrospect when they had not effectively communicated within the scenario:

*“I feel like I could have spoken more clearly about what I had done, like I think you were good at being like ‘this is the fluid I’ve given’ or ‘the chest is clear’ and I think there were times when I just did something and I think it would be better if I had been like ‘this is what I found’.”*

Observing students were able to recognise instances where a shared understanding had not been established and the bearing this had on the management of the patient:

*“I think this was the point where I said they are going with the management plan, but no one has said it explicitly that they all agreed it was coronary and they were going to go down that route.”*

#### **4.4.5 Working with peers and seniors**

Students appeared to find it easier to work together and get help from their peers than from senior doctors within the scenarios:

*“I think running things past each other a lot was good, and teaming up for things like bloods and examinations and all that kind of stuff, it just makes you feel more confident in what you’d done as well. So yeah, it was a more relaxing environment to work in with everyone knowing and happy with everything.”*

Students were able to identify strategies where they could seek support from their peers prior to seeking help from a more senior doctor:

*“I think you’ve raised a fair point, because the med reg is probably going to say ‘have you given these?’ so it is good idea to maybe get them on board before, but maybe one of you could be doing that whilst the other person is phoning so you could be doing it at the same time.”*

*“But I suppose like, if you know in your head that’s what you are going to give him and you’d already started to write the stuff up, putting the phone call in then with a view to saying ‘in the next five minutes we’ll get all these drugs and then if you come down’ that may be a fair way of going about it.”*

Students also recognised the difficulties associated with speaking up and challenging doctors:

*“I guess we don’t like saying to colleagues ‘I think you are wrong’, I think that’s quite a big thing to be honest. I don’t know if you felt that way but if I thought a senior or a colleague of mine was wrong I would be very hesitant.”*

## 4.5 Discussion

This study used generic TDGs to introduce a NTS framework to students and highlight the importance of NTS in emergency situations. Thereafter, students were able to describe multiple examples of effective and ineffective NTS behaviours in acute care simulation scenarios. Some of these NTS were generic whilst others were more specific to the context of looking after an acutely unwell patient as a junior doctor. For example, students recognised in retrospect situations where they should have escalated care earlier, but had not done so due to a perceived requirement to complete certain tasks first. Indeed, in some situations students appeared to find it more difficult to apply effective NTS behaviours whilst participating in real-time scenarios. This could be attributed to a number of different factors including unfamiliarity with the responsibility of managing acutely unwell patients, being overwhelmed by the decision-making required in the scenarios and complex workplace culture influences on decision-making.

As defined in Chapter 1, situation awareness is “the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future” (Endsley et al. 1995). Students were clearly able to identify the importance of maintaining situation awareness within the clinical scenarios and were able to identify situations where situation awareness had been lost. In many cases, loss of situation awareness was due to students focussing on a particular aspect of the task to the detriment of the overall management of the task. Fixation errors occur when the practitioner

concentrates on a single aspect of a case to the detriment of other more relevant aspects (Fioratou et al. 2010b). Novices and experts alike can be affected by fixation errors when they are blinded to the bigger picture by focussing on a particular aspect of a case. In the acute care simulation scenarios students tended to fixate on a short-term tangible goal to the detriment of maintaining more global awareness of increasingly complex situations. For example, students in one scenario fixated on applying an oxygen mask to a confused patient who kept pulling the mask off, when adequate oxygenation may have been achieved through alternative methods such as nasal cannula. Increasing awareness of fixation would enable students to assess their own tendencies towards fixation and to recognise situations when other team members might exhibit this behaviour. Clearly, in this latter situation it is also imperative that they feel empowered to speak up to ensure the group understands their concern.

Distributed situation awareness (DSA) refers to each member of the clinical team sharing a common understanding of the clinical situation (Fioratou et al. 2010a). This requires individual team members to take responsibility for their own understanding of what is going on whilst also ensuring this understanding is shared by the wider group. Delany has called for experts to make their thinking visible and accessible to students when teaching clinical reasoning (Delany and Golding 2014). Justifying the rationale behind decision-making has wider consequences in medicine. For example, the drug ramipril is more commonly prescribed for hypertension than proteinuria, and Foundation doctors may not recognise when the drug has been prescribed for proteinuria if this has not been made explicit by the prescribing

clinician. This may in turn lead to the drug being inappropriately stopped if the patient has normal blood pressure. Experts and novices alike making their thinking visible would facilitate distributed situation awareness and reduce the likelihood of errors occurring. However, it may be more challenging for junior team members to make their thinking visible in hierarchical teams where they might find it more difficult to speak up.

Students recognised that even in a non-hierarchical team “speaking up” can be challenging and in particular it can be difficult to say to a colleague that they think they are wrong. Srivastava recognised these challenges in an editorial in the New England Journal of Medicine, describing in detail an example of a case where even as an experienced clinician she did not speak up and regretted this in retrospect (Srivastava 2013). Srivastava describes failing to voice her concerns that a patient was not fit for surgery. The patient subsequently died in the Intensive Care Unit shortly after surgery. Srivastava goes on to conclude that “recognising the pitfalls of blind adherence to hierarchy and broaching... [Vocalising] my misgivings about a patient: such an ‘intervention’ seems deceptively simple, uncontroversial.”

Students delayed calling for help because of a perceived expectation that they should have accomplished more on their own prior to calling for help. This is consistent with research that has described two underlying principles that underpin deciding when to call for help: to act responsibly when dealing with patients and to progress and develop towards independent practice (Stewart 2008). As such, trainees may be

reluctant to call for help unless they perceive that failing to call for help may have adverse consequences for the patient. Kennedy described trainees' decisions about whether to seek senior support to be influenced by the clinical question, supervisor factors and trainee factors including a desire for independence (Kennedy et al. 2009a). Kennedy went on to describe strategies that trainees use to "preserve credibility" when requesting clinical support from a supervisor. These included situations where trainees would preferentially seek help from less "powerful" members of the team, to avoid exposing a lack of clinical knowledge or skill to a supervisor (Kennedy et al. 2009b). TDGs can be used to introduce or reinforce the importance of the medical hierarchy and to highlight the potential consequences of not speaking up in hierarchies.

Croskerry noted that many diagnostic errors are associated with cognitive failure, predominantly with how we make decisions rather than a lack of knowledge (Croskerry 2015). For example, students knew that decision-making could be improved by spending time looking at the patient's notes but did not return to the notes even after establishing that the patient was stable. It is encouraging that students recognised cognitive failures in retrospect and subsequent debriefing could focus on raising awareness of models of decision-making. This could also be emphasised in real-time in simulation scenarios through the use of strategic prompts, such as asking students to consider if they have gathered information from all available resources.

One such strategy is through developing an understanding of dual-process theory. Dual process theory acknowledges that doctors (and indeed everyone else) utilise a combination of intuitive and analytical processes to make decisions and the key to good decision-making is to be in the right mode at the right time (Croskerry 2003; Croskerry and Nimmo 2011; Scott 2009). An intuitive decision involves utilising prior experience to identify a course of action that it is likely to be effective whilst in analytical decision-making a range of options are generated and the single best option selected (Klein 1998). Intuitive processes tend to be quicker, cognitively sparing and are often used by experts in emergency situation, facilitating rapid decision-making. However, medical students are relative novices and should be encouraged to use analytical decision-making in unfamiliar situations. Inappropriate heuristics (mental short-cuts) could have severe clinical consequences. For example, prescribing intravenous fluids as an intuitive response to a low urine output may be hazardous if the patient has dialysis-dependent renal failure. An understanding of how experts and novices make decisions is also important when designing NTS training such as TDGs. This is considered later in this thesis.

Students were able to recognise situations in the debrief interviews where they had not demonstrated optimum NTS in real-time. This highlights the key role of effective debriefing. Systematic review has identified feedback as the most important feature of simulation-based medical education (Issenberg et al 2005). More specifically, Cheng suggests, “The hallmark of debriefing is the interactive, bi-directional and reflective nature of discussion, whereas feedback without debriefing is a unidirectional communication about the recipient’s behaviour” (Cheng et al.



2014). In this study, debrief interviewing was intended to probe the students' understanding of NTS but the debrief itself may also have contributed to NTS development. For example, students sometimes recognised through the debrief situations where they could have made more effective decisions through sharing their ideas and concerns with other team members.

#### **4.5.1 Limitations**

This is a single-centre study and it cannot be assumed that findings transfer beyond the context in which it was undertaken. A single researcher facilitated all sessions and sessions may have run differently if facilitated by others. It is unclear to what extent the students' behaviour in the simulation sessions and their responses in the interviews were influenced by participation in the TDG sessions. It would be of value to compare with a similar group of students who did not participate in the TDG sessions. However, to make meaningful comparisons would require a mixed-methods approach, likely involving use of a NTS scoring system that can reliably differentiate between/amongst students. There was insufficient reliability data to support using the acute care behavioural marker system (Mellanby et al. 2014) in this way when this study was carried out.

## 4.6 Conclusion

This study found that students were able to recognise, understand and discuss the importance of NTS after participating in generic TDG and acute care simulation scenario sessions. However, recognition and understanding of the importance of NTS did not always translate into effective NTS behaviour in real-time clinical scenarios. Students found it difficult to maintain situation awareness, often due to fixation on particular aspects of the task. Students were uncomfortable with uncertainty and this influenced behaviour in the tasks. Students also struggled to escalate care and indeed had difficulties speaking up even in a non-hierarchical environment.

This study suggested that generic TDGs might contribute to developing NTS that transfer into more clinical contexts. However, it was unclear to what extent the students' behaviour in the simulation sessions and their responses in the interviews were influenced by participation in the generic TDG sessions. It was recognised that further work would be required to better elucidate the relationship between learning from the generic TDG sessions and clinical contexts. Nonetheless, the acute care simulation scenarios appeared to build on the NTS developed through the generic TDGs. How different NTS strategies including generic TDGs and acute care simulation scenarios may be used in a complementary way is discussed further in Chapter 7.

## **Chapter 5: Medical TDGs - an innovative way of developing NTS**

### **5.1 Introduction**

Chapter 3 found generic (non-medical) TDGs to be a feasible and acceptable way of teaching final year medical students about NTS. Chapter 4 found that students were able to recognise, understand and discuss the importance of NTS after participating in generic TDGs and acute care simulation scenarios. However, as outlined in Chapter 1, other safety-critical industries have used a combination of generic and domain-specific TDGs to develop NTS. The limited literature describing the use of domain specific TDGs in healthcare contexts has also been described in Chapter 1. There did not appear to be readily available medical TDGs that could be utilised with Year 5 medical students.

This chapter will describe the process by which two acute medical TDGs suitable to use with Year 5 medical students were developed. It begins with a description of the development of the medical TDGs through collaboration with colleagues including national experts in NTS and simulation-based education at an “expert panel” meeting. Thereafter, follows a detailed description of the process of running medical TDG sessions with follow-on focus groups with final year medical students.

### **5.1.1 Ethics**

The University of Edinburgh committee on the use of student volunteers prospectively approved the study described in this chapter.

## **5.2 Chapter aims**

The aim of this study was to explore the potential role of medical TDGs as a novel method of developing final year medical students' NTS. The first objective of this chapter was to develop medical TDGs in a theoretically robust way. Thereafter, the main objective was to explore how they may be used to develop final year medical students' NTS. A further objective was to explore and understand how NTS learning from medical TDGs might complement learning from generic TDGs and acute care simulation scenarios.

## **5.3 Methods**

As described in Chapter 2, this was a constructivist study utilising grounded theory methodology. This section describes the detailed methods used in this study.

### **5.3.1 Developing acute medical TDGs**

When considering a starting point for developing medical TDGs, it was helpful to reconsider the principles of TDG design described by Schmitt. Specifically, in addition to encompassing elements of uncertainty and ambiguity, Schmitt recommended that TDGs should be: interesting, challenging, plausible, accurate,

contain the right amount and proper type of detail, allow for multiple interpretations and solutions and have a reasonable time limit (Schmitt 1996).

As when designing the acute care simulation scenarios, it was important that medical TDGs should reflect common clinical situations faced by newly qualified doctors and be written in such a way as to require exercising a range of NTS. Uncertainty and ambiguity had emerged as key themes in the studies described in Chapters 3 and 4 and it was therefore highly desirable that scenarios should also reflect the uncertainty and ambiguity of the clinical world.

Again, I drew on my own clinical experience and considered clinical handover as a starting point. At handover, doctors are provided with a number of tasks that are required to be undertaken during their forthcoming shift. This may involve working in a Hospital at Night (HAN) team where Foundation doctors may be responsible for a wide number of patients over a range of wards, many of whom they have never met before. Sometimes, the information provided is limited, ambiguous or frankly inaccurate and handover may be interrupted by the addition of further tasks, such as a telephone message from a nurse without complete information being available. Moreover, handover is often carried out distant from ward areas so that direct observation, case notes and patient charts are not readily available. Foundation doctors (along with more senior doctors and other health care professionals) are then required to develop a preliminary strategy that will enable them to execute the tasks handed over to them in a timely and safe way. They do this in the knowledge that

further tasks are likely to be added in an unpredictable manner over the course of their shift.

I developed two acute medical TDG scenarios drawing on my own experiences of clinical handover. This included my own direct experience working as a junior doctor and more recent experience supervising Foundation doctors. The TDGs contained common tasks that students could expect to encounter in their first year of clinical practice, such as reviewing a patient with asthma or prescribing intravenous fluids. Students would be required to prioritise these tasks and develop a strategy to carry them out in real-time, despite interruptions. The scenarios would be time-limited and would require students to make decisions and commit to them in a real-time setting. Students would have a limited opportunity to request further information about some of the tasks. Draft medical TDGs were shown to an experienced medical registrar, a more junior doctor (immediately post-Foundation) and a clinical skills facilitator and some of the tasks were fine-tuned following their feedback. The medical TDGs developed are shown in Figures 27 and 28 respectively.

### **Figure 27 – Medical Tactical Decision Game 1**

You are working in a district general hospital and are working on nights in the medical team. There are only 2 junior doctors (FY1+FY2) in the overnight medical team. There is also a medical registrar on-call but he has gone straight to A&E and has intimated that he expects to be there for some time. There are 2 Hospital at Night (HAN) practitioners in the hospital but they are not at the handover. Remaining team members have been working during the day and are present at handover but will be going home thereafter.

The following tasks are outstanding. Your task is to decide how you will prioritise the outstanding tasks and justify the decisions that you have made. You may ask up to 3 questions to clarify any information.

- 1) A 75-year-old male on the geriatric rehabilitation ward is demanding to leave the hospital.
- 2) A 16-year-old female has been sent up to medical admissions from A&E after an alleged overdose. She would not tell the A&E doctor what tablets she took. Her SEWS score is 0.
- 3) A 24-year-old female was admitted with acute asthma earlier in the afternoon. Her peak flow at admission was 260l/min. She has completed nebulised salbutamol and ipratropium and the admissions nurse has asked for her to be reviewed.
- 4) The daughter of a 90-year-old terminally unwell man has arrived back from her holiday in New Zealand and is apparently very upset and asking the nurses why active treatment has been withdrawn. She is demanding to speak to a doctor this evening.
- 5) An 85-year-old lady in the acute geriatric ward has fallen on the way back from the toilet. She insists she feels fine and has told the ward nurses “not to bother the doctors”.
- 6) The consultant has asked for a junior doctor to join his on-going post-take ward round after the handover as “it will be quicker if someone scribes in the notes for me”.
- 7) Three patients on a general medical ward require IV cannulae to be re-sited in order for IV antibiotics to be administered.
- 8) A 25-year-old female admitted yesterday with suspected acute pyelonephritis has spiked a fever to 38.5 C. She has a history of polycystic kidney disease.
- 9) 4 patients from a general medical ward require IV fluids to be prescribed.
- 10) A 94-year-old lady on the geriatrics ward has not passed urine for 6 hours. The nurse mentions that she has a DNACPR form in place and usually lives in a Nursing Home.
- 11) A 30-year-old man with cellulitis has just been seen and discharged by the on-call consultant in medical admissions. He requires a prescription for antibiotics before he can be discharged.
- 12) An 85-year-old lady admitted to the general medical ward with heart failure complains of feeling breathless. Her SEWS score is 3.

## Figure 28 – Medical Tactical Decision Game 2

You are working in a district general hospital and are working on nights in the medical team. There are only 2 junior doctors (FY1+FY2) in the overnight medical team. There would usually also be a medical registrar on-call but he has called-in sick. There are 2 Hospital at Night (HAN) practitioners in the hospital but they are not at the handover and they have mentioned that the surgical wards are very busy tonight. Remaining team members have been working during the day and are present at handover but will be going home thereafter.

The following tasks are outstanding. Your task is to decide how you will prioritise the outstanding tasks and justify the decisions that you have made. You may ask up to 3 questions to clarify any information.

- 1) The intensive care unit (ICU) registrar has called to say that the ICU is very busy and she would like to “step-down” a 22-year-old man admitted there 3 days ago with acute severe asthma. She says he has been “absolutely grand” all day.
- 2) A 55-year-old man with alcohol-related liver disease and ascites has told ward staff that he can see spiders crawling on the roof of the ward.
- 3) The obstetric registrar has called to ask for a medical review of a 24-year-old woman who was admitted yesterday with suspected pre-eclampsia and has not passed urine for the past 6 hours.
- 4) A 35-year-old man admitted yesterday with a spontaneous pneumothorax has complained of worsening chest pain. His SEWS score is 1.
- 5) The Bed Manager would like a list of patients who are well enough to be boarded out of the medical unit overnight.
- 6) A 26-year-old man admitted following a paracetamol overdose is insisting that he be discharged. His paracetamol level results are not yet available.
- 7) A 90-year-old lady has had active management withdrawn by her consultant today. However, the ward nurses are concerned that she has not been written up for any anticipatory medicines and they cannot find a DNACPR form in her notes.
- 8) A 45-year-old man admitted with a sudden severe headache that morning and a normal CT brain is due a lumbar puncture (LP) at 10pm.
- 9) An 85-year-old lady on the geriatric rehabilitation ward has a SEWS score of 6.
- 10) A positive troponin result has been phoned through for a 46-year-old man. He was discharged with a diagnosis of “atypical chest pain” on the evening ward round.
- 11) A 68-year-old man has collapsed on the way back from the toilet. The ward nurse says his SEWS is 0 but he seems confused. He had been admitted for investigation of anaemia.
- 12) A 75-year-old man with a suspected urinary tract infection has been admitted from A&E. He has received 500mls crystalloid and a single dose of tazocin in A&E. He remains febrile at 38.3 C and has a SEWS score of 4.



This study aimed to focus on the potential role of medical TDGs as a novel tool to develop NTS rather than on the feasibility of utilising medical TDGs. To this end, it was important that the medical TDGs were as well developed as possible prior to running sessions with students. To further develop the medical TDGs, an “expert panel” meeting with two national experts in NTS and simulation-based education was organised at the Scottish Centre for Simulation and Clinical Human Factors.

#### **5.3.1.1 Expert panel meeting**

The theoretical basis for utilising an expert panel has been described in Chapter 2. In summary, it was envisaged that the expert panel meeting would: enable access to the knowledge and experience of the NTS experts; facilitate debate that challenged ideas and stimulated new ones and establish a degree of consensus (Humphrey-Murto et al. 2016).

Draft versions of the medical TDGs were sent to the NTS experts in advance of the expert panel meeting. With permission, the expert panel meeting was audio-recorded and I listened back to the recording within 24 hours of the meeting. A number of key learning points emerged from the meeting.

The briefing at the start of the medical TDG session would critically influence the session. Specifically, it needed to be clear to participants that their challenge was to develop a workable solution within a time-limited scenario, rather than looking for a “gold standard” solution. They needed to develop an overall strategy for the management of the outstanding workload, not just identify which patients might be

most unwell. This would encompass prioritising tasks based not just on clinical acuity, but also considering the difficulty of the task and likely time commitment.

There was a need to develop detailed facilitator's notes. These notes would essentially provide a comprehensive "back story" to the medical TDG cases and anticipate students' likely requests for further information. This would ensure a consistency of approach and would be particularly important if scenarios were subsequently run by less experienced individuals. The importance of this advice is further discussed in Chapter 6 when the integration of medical TDGs into the core undergraduate curriculum is considered. An experienced facilitator would still have the option of adding in information spontaneously in response to group dynamics, but there would be no absolute requirement to improvise. It was also envisaged that a well-developed back-story would also reduce the facilitator's cognitive load allowing them to focus on the students' NTS behaviours in preparation for the debriefing.

It would be useful to hold back details of some of the tasks at the outset and add them in as the scenarios progressed. This would add further realism and complexity to the scenarios. This could also contribute to allowing the level of challenge to be varied in a controlled way depending on how well a group were progressing without the facilitator being required to improvise. Increasing complexity could be added by telephoning in additional tasks depending upon the availability of additional facilitators.

It might be valuable for students to handover to someone else later in the scenarios, enabling them to take responsibility for delegating and coordinating. This could also involve coordinating feedback from what others have managed to achieve in a certain period of time.

Following the expert panel meeting the medical TDGs were developed into a suitable format to begin running sessions with students. This included detailed facilitator's notes as described above. Medical TDGs 1 and 2 with accompanying facilitator's notes are presented in Figures 29 and 30 respectively.

### Figure 29 – Medical Tactical Decision Game 1 with facilitator notes

You are working in a district general hospital and are working on nights in the medical team. There are only 2 junior doctors (FY1+FY2) in the overnight medical team. There is also a medical registrar on-call but he has gone to A&E and has intimated that he expects to be there for some time. There are 2 Hospital at Night (HAN) practitioners in the hospital but they are not at the handover. Remaining team members have been working during the day and are present at handover but will be going home thereafter.

The following tasks are outstanding. Your task is to decide how you will prioritise the outstanding tasks and justify the decisions that you have made. You may ask up to 3 questions to clarify any information.

- 1) A 75-year-old male on the geriatric rehabilitation ward is demanding to leave the hospital.

*He is normally well and independent living at home with his wife. He fell and sustained a fractured hip 2 weeks ago, which was surgically repaired within 24 hours. He has been slow to mobilise post-operatively with difficult pain control. He has been using a fentanyl patch for several days and the dose of the fentanyl patch was increased yesterday. Currently he is in a 4-bed ward and is shouting out that he wants to leave the hospital. However, he has not actually attempted to get out of bed.*

- 2) A 16-year-old female has been sent up to medical admissions from A&E after an alleged overdose. She would not tell the A&E doctor what tablets she took. Her SEWS score is 0.

*She took an impulsive overdose following an argument with her boyfriend. She is now calm and regrets the action. Her SEWS score is 0, her GCS is 15 and her ECG is normal. Her admission FBC, U&E, LFTs and coagulation screen were normal. Paracetamol and salicylate levels are awaited.*

- 3) A 24-year-old female was admitted with acute asthma earlier in the afternoon. Her peak flow at admission was 260l/min. She has completed nebulised salbutamol and ipratropium and the admissions nurse has asked for her to be reviewed.

*Her asthma control has been difficult over the last year and she has had 3 admissions including one to HDU but not ICU. She has never required intubation/ventilation for asthma. She does not monitor her peak flow at home. She is prescribed regular beclomethasone and salbutamol inhalers but often does not use them. She continues to smoke 10 cigarettes daily. Following the nebulisers she feels a bit better but is still wheezy. Peak flow is now 320l/min. SpO<sub>2</sub> is now 98% on high-flow O<sub>2</sub>. Her BP is 110/70, pulse 115. She has a 6 year-old daughter who is being looked after by her sister.*

- 4) The daughter of a 90-year-old terminally unwell man has arrived from New Zealand and is apparently very upset and asking the nurses why active treatment has been withdrawn. She is demanding to speak to a doctor this evening.

*He lived alone with a 3-times/day package of care prior to admission 6 weeks ago due to poor mobility and weight loss. A CT scan demonstrated extensive liver metastases and he was thought to be too frail for further investigation. He was thought to be too frail to return home and was awaiting a bed in a Nursing Home. However, he developed a chest infection a few weeks ago, which has not responded to antibiotics and on the ward round this morning the consultant advised that active medical treatment be withdrawn. The patient was too drowsy to engage in discussion but the medical and nursing team were supportive of the decision. The daughter from New Zealand is next of kin but has not seen her father for 5 years.*

- 5) An 85-year-old lady in the acute geriatric ward has fallen on the way back from the toilet. She insists she feels fine and has told the ward nurses “not to bother the doctors”.

*She tripped whilst wearing a pair of ill-fitting slippers. She managed to get back up by herself and now feels fine other than complaining of a sore knee. Her BP, pulse, SpO2 and temperature are unchanged from before the fall.*

- 6) The consultant has asked for a junior doctor to join his on-going post-take ward round after the handover.

*The medical registrar had to leave the ward round to go to A&E. The consultant has been working all day and is keen to get the ward round done as quickly as possible. He thinks he will get the ward round done quicker if he has someone to assist him by writing in the notes. He is aware that the registrar has gone to A&E but is unaware of the other tasks requiring to be done.*

- 7) Three patients on a general medical ward require IV cannulae to be re-sited in order for IV antibiotics to be administered.

*Patient 1: A 35 year-old man intravenous drug-user with infective endocarditis requiring IV antibiotics. He has very poor veins and required to have a central line inserted during a previous admission with cellulitis.*

*Patient 2: A 68 year-old woman with pneumonia who was switched from IV to oral antibiotics on the ward round this morning and in fact is no longer receiving any IV therapies.*

*Patient 3: A 55 year-old man with infective diarrhoea who continues to vomit and is receiving IV fluids. He had an acute kidney injury at presentation 2 days ago (urea 32, creatinine 368, K 4.2) though this has improved with IV fluid (urea 18, creatinine 186, K 3.8) and he is passing good urine volumes.*

- 8) A 25-year-old female admitted yesterday with suspected acute pyelonephritis has spiked a fever to 38.5 C. She has a history of polycystic kidney disease.

*She has CKD III (eGFR 54mls/min) and was admitted 2 days ago with high fevers, rigors and renal angle pain. She had leucocytes and nitrites in her urine and was septic with temperature 39.2, BP 95/56, pulse 126. She had an acute on chronic renal failure (creatinine 162) though renal function has now returned to baseline with treatment. She has been treated with IV fluids and IV antibiotics as per local protocols. No positive culture results are available. She has been intermittently febrile since admission and her temperature is now 38.3.*

- 9) 3 patients from a general medical ward require IV fluids to be prescribed.

*Patient 1: A 23-year-old man stepped down from HDU today following an admission with DKA. He continues on an insulin sliding scale. He is no longer acidotic and his glucose and electrolytes are normal. He is still nauseated and is managing little orally.*

*Patient 2: A 67-year-old man with CKD V is going for a coronary angiogram in the morning and requires IV fluid before receiving a large dose of contrast in the morning.*

*Patient 3: A 50-year-old woman admitted with diarrhoea and vomiting. She had an acute kidney injury at admission 3 days ago which has since resolved and she is now eating and drinking fluids. She is expected to go home tomorrow.*

- 10) A 94-year-old lady on the geriatrics ward has not passed urine for 6 hours. The nurse mentions that she has a DNACPR form in place and usually lives in a Nursing Home.

*She has been in the Nursing Home for 18 months and has become increasingly dependent. She is frail, has severe dementia and requires assistance with all activities of daily living. She was admitted 4 days ago with a pneumonia, which is not improving with IV antibiotics and IV fluids. She continues to receive IV fluids and antibiotics but her consultant has intimated that this would be the ceiling of care. Her family understand that she is very unwell and that she has a DNACPR form.*

- 11) A 30-year-old man with cellulitis has just been seen and discharged by the on-call consultant in medical admissions. He requires a prescription for antibiotics before he can be discharged.

*This man is normally well. He sustained a cut to his arm when he fell off his mountain bike and the wound became infected. He saw his GP who felt that he might need IV antibiotics. However, he has been reviewed by the medical consultant, who feels that he can be managed with oral antibiotics. He is very keen to get home as he now intends to catch a 7am flight to London for a business meeting in the morning. He is allergic to penicillin having had an anaphylactic reaction as a child.*

- 12) An 85-year-old lady admitted to the general medical ward with heart failure complains of feeling breathless. Her SEWS score is 3.

*She has severe mitral regurgitation but is unable to undergo cardiac surgery due to poor respiratory function. She does get out and about on a mobility scooter but cannot walk further than 50 yards due to breathlessness. She was admitted with increasing breathlessness 2 days ago and her diuretic dose was increased. She had been feeling slightly better until this evening. Her SpO<sub>2</sub> is 94% (2 litres nasal cannulae), BP 146/78, pulse 82. She is anxious but able to talk in complete sentences sitting up in bed. She does not have a DNACPR form and an escalation plan has not been discussed with the patient or documented in the notes.*

### Figure 30 – Medical Tactical Decision Game 2 with facilitator notes

You are working in a district general hospital and are working on nights in the medical team. There are only 2 junior doctors (FY1+FY2) in the overnight medical team. There would usually also be a medical registrar on-call but he has called-in sick. There are 2 Hospital at Night (HAN) practitioners in the hospital but they are not at the handover and they have mentioned that the surgical wards are very busy tonight. Remaining team members have been working during the day and are present at handover but will be going home thereafter.

The following tasks are outstanding. Your task is to decide how you will prioritise the outstanding tasks and justify the decisions that you have made. You may ask up to 3 questions to clarify any information.

- 1) The intensive care unit (ICU) registrar has called to say that the ICU is very busy and she would like to “step-down” a 22-year-old man admitted there 3 days ago with acute severe asthma. She says he has been “absolutely grand” all day.

*He has been admitted to ICU 3 times in the last 18 months due to asthma. He required intubation and ventilation on each of his previous admissions but not on this admission. He has been treated with nebulisers and a magnesium infusion. He now has SpO<sub>2</sub> 98% (R/A), BP 110/65, pulse 85 and peak flow 480l/min. His chest is clear to auscultation. He has been walking about the ICU today and the ICU consultant has reviewed him on the evening ward round and stated that he is well enough to step down to a general medical ward.*

- 2) A 55-year-old man with alcohol-related liver disease and ascites has told ward staff that he can see spiders crawling on the roof of the ward.

*He has been admitted 4 times in the last year. He drinks 8-12 cans of lager daily. He was admitted 2 days ago and commenced Pabrinex and chlordiazepoxide as per local protocols. He has been receiving additional as required chlordiazepoxide every 1-2 hours over the course of today. He is wandering around the ward and on several occasions has attempted to walk out of the ward. He is not currently aggressive and can be persuaded to return to his bed but is distracting nursing staff from providing care to other patients.*

- 3) The obstetric registrar has called to ask for a medical review of a 24-year-old woman who was admitted yesterday with suspected pre-eclampsia and has not passed urine for the past 6 hours.

*She is 34 weeks pregnant. This is her 1<sup>st</sup> pregnancy. She feels well. Her BP is 138/94. Her renal function was normal when last checked this morning.*

- 4) A 35-year-old man admitted yesterday with a spontaneous pneumothorax has complained of worsening chest pain. His SEWS score is 1.

*He is normally well with no significant past medical history though does smoke 10-15 cigarettes daily. A chest drain was inserted yesterday and a chest X-ray this morning demonstrated a reduction in the size of the pneumothorax. He has been receiving regular paracetamol only. The pain is around the site of the chest drain insertion. Current observations are: SpO<sub>2</sub> 97% (2 litres nasal cannulae), RR 18, BP 132/78, pulse 86.*

- 5) The Bed Manager would like a list of patients who are well enough to be boarded out of the medical unit overnight.

*There are no unoccupied beds in the medical unit. There are several patients in the emergency department who require admission to the medical unit. 3 of the patients in the emergency department have been in the department for more than 3 hours. The bed manager is concerned about missing targets for patients being seen and discharged from A&E within 4 hours.*

- 6) A 26-year-old man admitted following a paracetamol overdose is insisting that he be discharged. His paracetamol level results are not yet available.

*He claims that he took 16 paracetamol tablets earlier this afternoon following an argument with his girlfriend. He says he now regrets his actions but insists that he needs to leave as his dog is alone in the house. His SEWS score is 0, he is GCS 15 and his ECG is normal.*

- 7) A 90-year-old lady has had active management withdrawn by her consultant today. However, the ward nurses are concerned that she has not been written up for any anticipatory medicines and they cannot find a DNACPR form in her notes.

*She is a frail lady from a Nursing Home with a history of dementia. She was admitted 6 days ago with a pneumonia that has not improved with antibiotic therapy. Following discussion with her family active management was withdrawn this afternoon. She is currently sleeping and has appeared comfortable over the course of the afternoon and evening.*

- 8) A 45-year-old man admitted with a sudden severe headache that morning and a normal CT brain is due a lumbar puncture (LP) at 10pm.

*He has no past medical history of note. He was admitted following a sudden onset severe headache occurring at work at 10am. He works as an accountant. He has an on-going headache though it has now decreased in severity following opiate analgesia at admission. His GCS is 15 and his neurological examination is normal. His SEWS score is 0.*

- 9) An 85-year-old lady on the geriatric rehabilitation ward has a SEWS score of 6.

*She has a past history of hypertension and CKD III though prior to admission lived alone, was fully independent and played golf twice weekly. She was admitted 10 days ago following a fall where she sustained a fractured hip. This was surgically repaired. She has been making good progress on the rehabilitation ward and at the MDT yesterday the plan was to aim for discharge in around a week. She complained of feeling light-headed this afternoon but otherwise felt fine. She now has a fever (temperature 38.2), BP 95/65, pulse 110, SpO2 94% (R/A). She is complaining of feeling cold and shivery and the nurses noted that she has passed foul-smelling urine.*

- 10) A positive troponin result has been phoned through for a 46-year-old man. He was discharged with a diagnosis of “atypical chest pain” on the evening ward round.

*He was admitted through A&E this morning. He has no past medical history and takes no regular medications. He is a bus driver who smokes 20 cigarettes daily and takes no regular exercise. He developed right-sided chest pain in the supermarket this morning, which lasted for about 10 minutes and then spontaneously settled. His admission ECG was normal. He was assessed by A&E and admitted with a diagnosis of “unspecified chest pain – for troponin”. However, the medical consultant felt that ischaemic chest pain was unlikely and discharged him on the evening ward round with a plan to return to the chest pain clinic. He felt well at the point of discharge.*



- 11) A 68-year-old man has collapsed on the way back from the toilet. The ward nurse says his SEWS is 0 but he feels light-headed. He had been admitted for investigation of anaemia.

*He was admitted yesterday for urgent investigation of 2 stone loss of weight, over a 6-week period. His only PMH is of hypertension treated with ramipril. His Hb was 75g/l at admission and he is due to receive a red cell transfusion tomorrow. He felt light-headed and then collapsed on the way back from the toilet though he did not lose consciousness. His SEWS score is 0 though his BP has dropped from 160/95 at admission to 115/70 now.*

- 12) A 75-year-old man with a suspected urinary tract infection has been admitted from A&E. He has received 500mls crystalloid and a single dose of tazocin in A&E. He remains febrile at 38.3 C and has a SEWS score of 4.

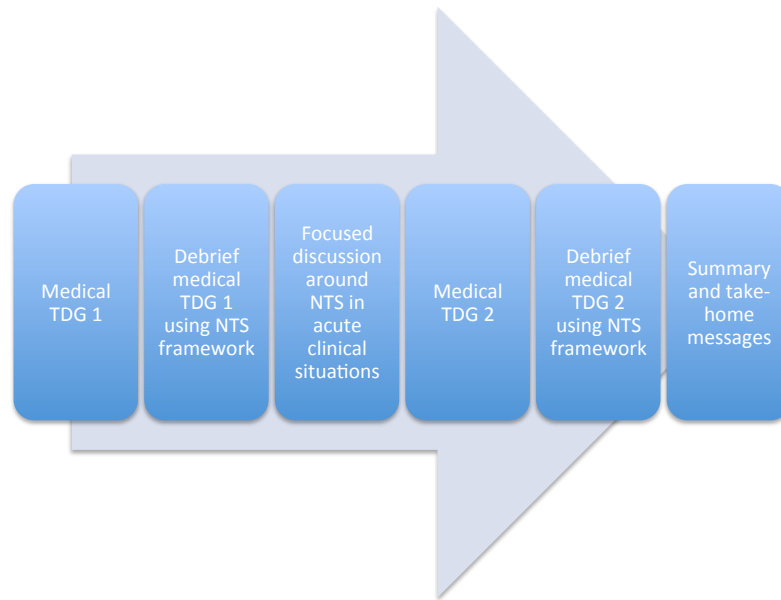
*He has a PMH of stroke and hypertension and has a long-term catheter. On admission to A&E he had a BP of 95/65, pulse 110 and temperature of 39.3. He has passed 100mls of urine in the 4 hours since admission to hospital. He has no further fluids or antibiotics prescribed. Currently his BP is 100/70, pulse 105, temperature 38.3 C.*

### **5.3.2 Medical TDG sessions with students**

The rationale for selecting Year 5 students in the medicine block has been outlined in Chapter 2. In summary, they had sufficient medical knowledge to enable focus on NTS and were at a stage of training where they should be focussing on preparation for practice as Foundation doctors.

It seemed both theoretically sound and pragmatic to adapt the structure that had been used to run the generic TDGs into a similar format for a medical TDG session. The initial format for the medical TDG sessions is presented in Figure 31.

**Figure 31 – Structure of medical TDG session with students**



It was envisaged that the focussed discussion around NTS in acute clinical situations would follow the same structure as that described in Chapter 3 and also include the audio clip of a junior doctor discussing her experience of looking after a critically unwell patient previously described.

Potentially eligible students were approached both by email and in person. 24 students undertaking general medicine attachments at Victoria Hospital Kirkcaldy provided written consent and voluntarily participated in a medical TDG session in four groups of six students. The composition of groups for each of the sessions is presented in Figure 32.

**Figure 32 – Number of students attending medical TDG sessions**

Medical TDG session	Number of participating students
1	6
2	6
3	6
4	6

Each session lasted between 75 and 90 minutes. Given the group sizes, all students participated in both scenarios in a single group within each of the sessions. This enabled them to apply learning from the first medical TDG debrief in the second medical TDG. I facilitated all of the sessions and the NHS Fife Clinical Skills Facilitator assisted by making and receiving telephone calls in two of the sessions. The potential benefits of a second facilitator are discussed in Chapter 6.

Following student feedback, the playing of the audio clip was dropped from later sessions and the NTS discussion between medical TDGs shortened. Students clearly recognised the importance of NTS in clinical contexts after participating in the first medical TDG and as such the audio clip was of less pivotal value than in the generic TDG session. None of the tasks in either of the medical TDGs changed, reflecting the rigorous process through which they had been developed. However, it had been suggested at the expert panel meeting that students should feedback how they would ensure they had achieved “closure” with respect to each of the tasks in the medical TDGs. Student feedback suggested they felt this involved too many hypothetical questions and therefore this aspect was dropped from later sessions. For example,

the further management of a patient with sepsis would depend upon her response to initial management with fluids and antibiotics.

All sessions were audio-recorded and field notes made both in real-time and when listening back to the audio recordings.

### **5.3.3 Focus groups**

Follow-on focus groups were used to gauge students' perceptions of participating in the medical TDG sessions and to inform the development of subsequent sessions. As stated in Chapter 2, focus groups were chosen as they encourage participants to critique colleagues' ideas and opinions (Kitzinger 1995). As in Chapter 3, I elected to conduct all of the focus groups myself. I felt this was critical, given that the findings would essentially be my own interpretation, consistent with constructivist grounded theory methodology.

All 24 students who participated in a medical TDG session participated in a focus group in the same four groups of six students. 100% student retention was achieved by pragmatically following-on the focus groups after the medical TDGs after a short break. The initial focus group topic guide is presented in Figure 33.

**Figure 33 – Medical tactical decision game focus group topic guide**

<p><b>Introduction</b></p> <p>Thank people for attending this session. Explain that the objectives of this session are to explore the feasibility of using medical TDGs to develop NTS and how to most effectively use medical TDGs to develop NTS. Emphasise that the underlying purpose of the study is to explore the role of TDGs as a method of teaching NTS to final year medical students.</p> <p>Remind participants that the session is being recorded and that whilst they may be quoted in educational research no comments or opinions will be attributed to them personally.</p> <p>Opportunity for questions</p> <p><b>Questions/points for discussion</b></p> <p>What were your key impressions of participating in this session?</p> <p>What worked well and what worked less well in the session?</p> <p>How effectively did the session cover the key NTS outlined in the discussion? Which NTS were clearly covered/not covered?</p> <p>What changes would you make if running this session with another group of Year 5 medical students?</p> <p><b>Close</b></p> <p>Thank everyone for participation</p> <p>Participants can listen to recordings or view transcripts if they wish</p> <p>Further opportunity for questions</p> <p><b>Notes</b></p> <p><b><i>Get everyone to introduce themselves at the start to facilitate transcription</i></b></p> <p>Aim to get everyone to contribute</p> <p>Encourage participants to comment on the views of others in the group</p>
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The focus groups were audio recorded and transcribed verbatim.

### **5.3.4 Data analysis**

Data analysis was underpinned by constructivist grounded theory methodology, enabling emerging themes to be further explored in subsequent focus groups (Ritchie

and Lewis 2003; Charmaz 2006). For example, as “understanding capabilities and responsibilities of team members” was identified as a potential theme it was added to the focus group topic guide. Analysis was again undertaken with the assistance of NVivo Version 10 (QSR International Pty Ltd, Doncaster, Vic, Australia) software. I had no predefined codes and proceeded with inductive (and subsequently deductive) coding similar to that described in Chapter 3 until emergent themes began to develop. Rigour was added by the independent coding of the data by SK. SK is a trained psychologist and provided a valued complementary perspective. Where differences in themes were identified these differences were discussed and resolved until consensus was achieved.

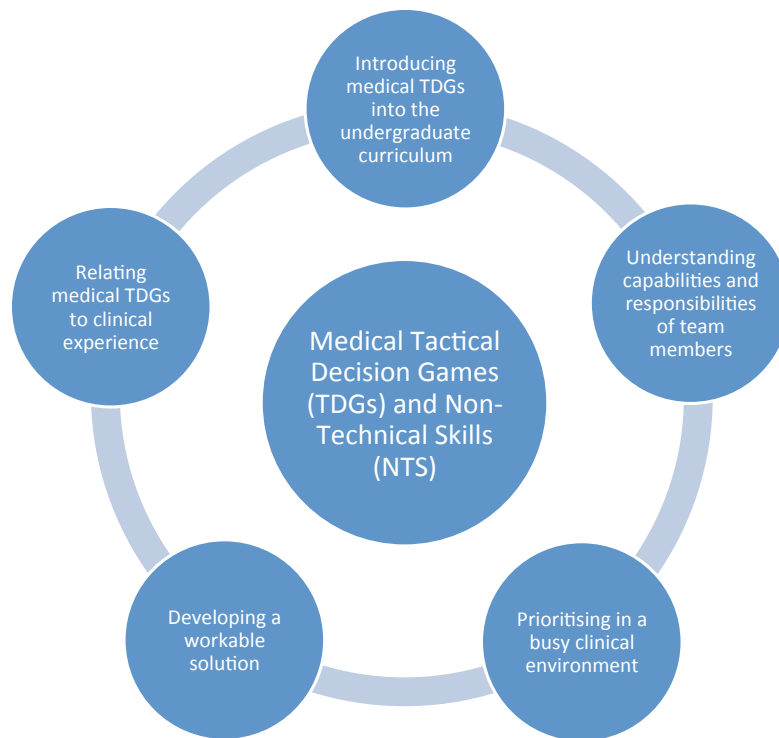
## **5.4 Results**

The main objective of the study described in this chapter was to explore the potential role of acute medical TDGs as a novel method of developing final year medical students’ NTS.

With respect to this research question, five key themes emerged from the data:

“understanding capabilities and responsibilities of team members”; “prioritising in a busy clinical environment”; “developing a workable solution”; “relating medical TDGs to clinical experience” and “introducing medical TDGs into the undergraduate curriculum”. The themes are displayed in Figure 34.

**Figure 34 – Diagrammatic representation of themes**



### **5.4.1 Understanding capabilities and responsibilities of team members**

The medical TDGs highlighted to students that they were unfamiliar with the skill-set and responsibilities of wider members of the team:

*“I think what limited us a bit was our lack of experience, not being aware of the roles of the advanced nurse practitioners – what they can and can’t do, if they can prescribe, what’s in their capacity to do, and then whether or not we would bother the consultant – who we would call if someone’s not on, is there an on call? We just didn’t really know the structure of the team...”*

Students recognised that they did not have experience of delegating tasks to other team members and were unclear on when it was appropriate to delegate:



*“The thing I find most difficult isn’t necessarily deciding which patient is the most sick, but deciding what asks I can make on other people. I don’t know whether it is within my remit to say ‘please can you do this?’ or I don’t know whether I am expecting them to turn round and say ‘no, that’s your job’.”*

Participation motivated students to be pro-active in seeking to understand the set-up in the hospitals in which they will be working:

*“It also prompts you to think ‘gosh, I really need to know how the hospital works’ and you know what kind of questions to ask on your induction.”*

The medical TDGs highlighted the importance of knowing *how* to effectively escalate care when looking after deteriorating patients:

*“And also thinking through the practicalities of how to call for help; you can’t just shout help. You need to know who to phone, and how to call – how to get hold of them, and what information they are going to want and need to know from you.”*

#### **5.4.2 Prioritising in a busy clinical environment**

One of the greatest challenges faced by newly qualified doctors is the need to prioritise tasks. Students recognised that the medical TDGs highlighted the need to prioritise tasks and required them to do so:

*“Well, this dynamic prioritisation, I think was what you called it, I was aware that you would be called in to other jobs and things, but I don’t think it REALLY occurred to me and so it was quite good to have the practise with that.”*

Participation required students to adopt the way of thinking that they would require when prioritising tasks as a junior doctor:

*“I think it’s the experience of actually experiencing this way of thinking. It’s something you can’t get out of a book. In a book it might say ‘when you are on a ward you must do the most important task first’, and although that is fine, a valid point, but it doesn’t tell you how to do it. I mean, having to think about nine or ten scenarios that are all happening at the same time with a limited amount of resources and with the time pressure – experiencing that is vastly more useful than just reading a book that’s saying ‘you’ve got to do the first things first....’”*

Participation highlighted the complexity of prioritising tasks and the need to think beyond triaging the un-wellness of individual patients:

*“I think it’s quite good that we get to know prioritisation is not about just sick people, but also time management of how long do we need to do a job, and actually trying to balance both ill patients and how fast you can do the job.”*

### **5.4.3 Developing a workable solution**

Students recognised that with limited time their objective was to come up with a pragmatic strategy for the overall management of the task and that it was neither feasible nor desirable to search for a perfect solution:

*“We could come up with a perfect thing, but it could take us one hour to decide what the best thing to do is, but in real life we work under time pressure and the more time we take to plan what we are doing, the less time we have to actually do them.”*

By working effectively in a team students were able to discuss their respective rationales for decisions made and thereby develop a workable solution:

*“Well I learnt a lot anyway and I think, just going through what I initially thought when I read out things compared to when we spoke about it, not that I disagreed with what the team decided but going through the rationale made me maybe change some opinions and I think it was good to work through it and see the rationale behind our priorities and our strategies.”*

Students regarded the medical TDGs as a practical activity that enabled them to apply their medical knowledge in a meaningful way:

*“Yeah I thought it was a great way to bring a lot of different knowledge together, and put a practical aspect to it, prioritising which information is more important and more immediate than this, and how you are going to deal with various tasks with various different members of the team – whose skills are appropriate to which task.”*

Students recognised that their approach developed between the two medical TDGs:

*“I think our plan this time is significantly different to last time, in the first task we gave a planned series as you were saying, this person does this task and then that task and depending on whether someone has done that task then they move to that*

*task, whereas here we had two people working in, well they know what each other are doing, but in parallel, which I think is a completely different structure of plans to what we had before.”*

#### **5.4.4 Relating medical TDGs to clinical experience**

Students regarded the medical TDGs as a realistic activity that required them to think and to behave like they will have to in the clinical environment:

*“I thought it was really good, I thought it was a much more realistic representation of what we are going to have to be faced with whereas the only previous sort of exposure to this sort of thing we’ve had was the SJT [situational judgement test], and this was much more in real time and dynamic and we actually had to make phone calls and stuff.”*

Students related the scenarios they encountered in the medical TDGs to their own clinical experiences on the wards:

*“I think that’s quite realistic in that respect, having just come from assistantship and having seen that often, so often the FY [Foundation year doctor] was asked to go and see someone with practically no information to go on, and the FY quite often had two or three people that she was being asked to kind of cast an eye over by the nurses but would often have to go back and get more information in order to prioritise.”*

Students also commented that their participation in the medical TDGs would influence their approach to forthcoming clinical sessions:

*“We are starting nights on Monday...thinking about that and ‘oh when I am there on Monday I am going to be watching how they prioritise and I am going to be trying to think about why they are doing it’, so I think like, taking away from it is getting into the rationale behind why these different priorities are made and these strategies are made, and the need for them as well.”*

#### **5.4.5 Introducing medical TDGs into the undergraduate curriculum**

Students supported the introduction of medical TDGs into the undergraduate curriculum and felt that the scenarios were appropriate for final year:

*“I believe that these exact scenarios are perfect for the beginning of year 5 because we have got all the necessary knowledge to address each one individual medical issue, so the medical side is clear to us, and then just using our medical knowledge we are prioritising things – and also at the same time learning the practical aspects of it. So I agree that now is perfect...”*

The clinical assistantship was highlighted as potentially an ideal time for the activity as it would allow students to apply the learning from the medical TDGs in a clinical context:

*“I think the assistantship would probably be a really good time to do this because you are shadowing a doctor and then you are trying to observe these skills as well, but it’s helpful to have these types of sessions where you can actually explain what you are thinking, instead of just observing what the FY is doing.”*

There was enthusiasm for undertaking the activity earlier in the curriculum, provided the activity was adapted to the appropriate level and clinical discipline:

*“I think this kind of experience should come a lot earlier in medical school. I think as soon as you start learning about a particular system.”*

## **5.5 Discussion**

This study found that medical TDGs represented credible real-world scenarios that were straightforward to run in a classroom setting with a single facilitator. Medical TDGs appeared to be an innovative way of developing a wide range of NTS.

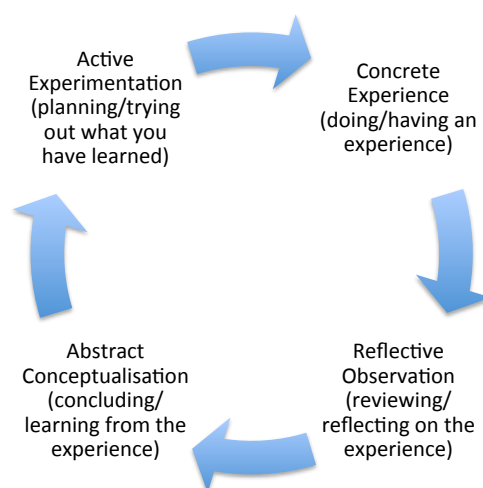
Specifically, they required students to prioritise tasks to ensure safe management of a number of patients simultaneously. Brown found that Foundation doctors ranked task prioritisation as the most important NTS for working out-of-hours (Brown et al. 2015). However, prioritising tasks amongst a number of different patients is not developed in conventional acute care simulation scenario teaching where students are usually responsible for the management of a single acutely unwell patient. Medical

TDGs also required students to make a number of decisions in a team and commit to these decisions in a time-pressured environment with limited and sometimes ambiguous information. This required students to rapidly process information and project ahead to consider potential consequences of a particular course of action, or indeed delay in taking any action at all.

Psychological fidelity appeared key to NTS development through participation in medical TDGs. Psychological fidelity is the extent to which the training environment prompts the essential underlying psychological processes relevant to key performance characteristics in the real-world setting (Kozlowski and DeShon 2004). Medical TDGs appeared to have high psychological fidelity with students describing requiring to think and act as they would in real-life clinical situations. There has been increasing interest in the importance of psychological fidelity in simulation-based education (Maran and Glavin 2003; Norman et al. 2012; Hamstra et al. 2014). Key to this interest is that psychological fidelity is associated with increased transfer of learning and generalisability (Kozlowski and DeShon 2004). This means that individuals are able to adapt knowledge and skills acquired during training to more difficult, dynamic and complex situations. This is particularly attractive in medicine, which is inherently so complex and varied that it will never be possible to encounter every possible eventuality in a simulated setting. Psychological fidelity enables the use of cost-effective low physical fidelity simulations that nonetheless maximise transfer and generalisability (Kozlowski and DeShon 2004). This is of further interest given the high costs associated with high physical fidelity simulation.

Medical TDGs can be regarded as a form of experiential learning and the activity can be related to the principles of experiential learning outlined in Kolb's learning cycle (Kolb 1984). Kolb described a cycle in four stages: concrete experience, reflective observation, abstract conceptualisation and active experimentation (Kolb 1984). Kolb's learning cycle is shown in Figure 35.

**Figure 35 – Kolb's learning cycle**



Medical TDGs allowed students the opportunity to make decisions and indeed mistakes in a safe environment, receive feedback on these decisions, reflect on the experience and then “have another go”. The medical TDGs also encouraged students to relate their concrete experiences in the learning activity to observations and reflections from their clinical attachments. Furthermore, students were motivated to apply the learning from the medical TDG activity to their forthcoming clinical experiences. The importance of this finding is discussed further in Chapter 7.

The medical TDGs required students to make clinical decisions and develop a workable solution in a time-pressured environment with limited and sometimes ambiguous information. Students recognised that the priority was to come up with a pragmatic solution in the time provided rather than spending a longer period of time seeking a perfect solution. The time-pressured nature of the medical TDGs meant that it was not feasible for students to analyse each task in depth and some decisions were required to be made more intuitively. For example, an appropriate intuitive response to the task involving the patient discharged with a positive troponin is to call and advise him to return to hospital immediately. Decisions regarding his further management can be deferred until he arrives back at the hospital. As discussed in Chapter 4, this is consistent with real-world settings where doctors utilise a combination of intuitive and analytical strategies to make decisions and prioritise tasks (Klein 1998; Croskerry 2015). Klein described both intuitive and analytical decision-making and found that experts tend to rely on intuitive decision-making when they need to make rapid decisions (Klein 1998). Foundation doctors

are, of course, not experts but a degree of decision-making experience can be accrued in a safe environment through participation in medical TDGs and other NTS training contexts.

Effective teamwork is crucial to the delivery of safe healthcare (Weaver et al. 2014). As described in Chapter 1, a particular challenge is that junior doctors work in rapidly changing teams that often come together on an ad-hoc basis such as in cardiac arrest and other emergency situations. Junior doctors will also frequently rotate around different hospitals and departments where they will encounter a range of different hospital systems. It is therefore important that they develop an understanding of hospital systems and the skills required to adapt to changing clinical environments. Medical TDGs required students to consider team members' skills, responsibilities and limitations in order to allocate tasks and manage workload effectively.

We found that senior students, including those within a few weeks of starting practice as junior doctors, were uncertain of the roles and responsibilities of members of the wider team. Medical TDGs familiarised students with roles and responsibilities of some team members. However, perhaps more importantly, the activity made students aware of their lack of wider understanding of this issue and the need to rapidly familiarise themselves with clinical environments when they commence clinical practice. Writing in *BMJ careers*, Shaw advised junior doctors managing the acute take of the importance of familiarising themselves with the team members with whom they will be working and their respective roles (Shaw et al.



2010). Whilst medical TDGs served as a way of familiarising students with the clinical team, it is somewhat concerning that this information did not appear to have been provided in other contexts. In addition, it is likely that time spent discussing roles and responsibilities of team members in the debriefing occurred at the expense of other NTS learning.

Escalating care is a crucial skill required to work safely and effectively in a team. There are many barriers to calling for help and newly qualified doctors have consistently reported difficulties in knowing when to appropriately seek senior input (Illing et al. 2008; Stewart 2008; Kennedy et al. 2009). In Chapter 4, students struggled to escalate care appropriately, despite recognising when they should have done so. Medical TDGs encouraged junior doctors to escalate care where appropriate and to consider the practicalities of when and how they would do this in real-world clinical settings. For example, students were required to recognise that the pre-eclampsia case required to be escalated to the obstetrics consultant and this needed to be made explicitly clear to the obstetrics registrar. If the obstetrics registrar did not agree then the Foundation doctor required to inform the on-call medical consultant of the situation. Escalating care in medical TDGs could complement the process of calling for help required in the acute care simulation scenarios described in Chapters 3 and 4 and is discussed further in Chapter 7.

Students felt that final year was an appropriate time in the curriculum for the activity. At this stage in training students already have considerable medical knowledge and focus turns to the application of that knowledge in clinical practice. Students

suggested that the clinical assistantship would be an ideal time to incorporate the medical TDG activity. The assistantship was introduced into UK undergraduate curricula following a General Medical Council (GMC) requirement that all students experience a period during which they act as an assistant to a junior doctor, with defined duties under appropriate supervision (GMC 2009). As such, the focus of the assistantship is on preparation for practice and the practicalities of getting the job done.

### **5.5.1 Limitations**

This is a single centre study and it cannot be assumed that the results of this study are transferable beyond the context in which the study was undertaken. The same facilitator led all sessions and at this point it was uncertain how sessions would have run with a different facilitator. I conducted all of the focus groups myself and my professional background and wider involvement in the study will have informed the data gathered in the focus groups and the subsequent data interpretation. In this context, rigour was added by the independent coding of the data by SK. Students were not interviewed at a later time point and so we only know that students *intended* to apply learning from the session in clinical practice. It remains uncertain if learning from the medical TDG session subsequently translated into behavioural change in the clinical environment. As such the impact of the activity on clinical outcomes was uncertain.

## **5.6 Conclusion**

This was the first description of the development of acute medical TDGs and their use within undergraduate medical education. Acute medical TDGs appeared to be an innovative and exciting way of developing final year medical students' NTS.

Psychological fidelity appeared to be key to the educational value of this activity that encouraged students to make decisions and prioritise tasks in real-time utilising the skills and expertise of the wider clinical team. Students valued the sessions and felt that participation would influence their behaviour in clinical settings. Evidence from the psychology literature supported this construct (Kozlowski and DeShon 2004).

However, it was recognised that further studies would be required to explore whether and how learning from the medical TDG sessions informed subsequent clinical practice.

# **Chapter 6: Developing a sustainable programme of NTS training**

## **6.1 Introduction**

Chapters 3-5 have explored how generic TDGs, acute care simulation scenarios and medical TDGs might be used to develop final year medical students' NTS. Through dissemination, including publications, reports, presentations and word of mouth, it is hoped that these studies may inform NTS training programmes nationally and internationally. A key further objective of this research was to develop a sustainable programme of NTS teaching through TDGs that complements existing NTS training within the University of Edinburgh medical curriculum.

This chapter will describe the process of integrating medical TDGs into the core curriculum. It will describe the processes of recruiting and training a team of facilitators, medical TDG delivery and evaluation to ensure that sessions met appropriate learning objectives. There follows a description of a project that has grown from the work described in this thesis and contributed to further sustainable NTS teaching within the Edinburgh curriculum.

## **6.2 Chapter aims**

The aim of this chapter is to describe the development of a sustainable programme of NTS training that would be of lasting value in the Edinburgh medical curriculum beyond the lifespan of the work presented in this thesis.

## **6.3 Methods**

### **6.3.1 Defining the NTS teaching to be delivered**

All the work described in Chapters 3-5 was carried out with a small number of volunteer students and facilitated by me. The challenge now was to deliver a sustainable programme of NTS teaching on a larger scale.

It was important that NTS teaching through TDGs complemented existing NTS training within the Edinburgh curriculum. Whilst there was some NTS training in earlier years in the curriculum, for example teamwork in problem based learning (PBL) sessions, NTS teaching occurred most often in the final year. For example, all final year students attend a high fidelity simulation NTS session and a simulation ward round session. There was the opportunity to introduce either generic or medical TDG teaching and the latter was selected for a number of reasons. It was clearly evident that there was NTS learning, particularly around dynamic prioritisation, that was strongly emphasised through the medical TDGs. It was envisaged that this could complement prioritisation teaching from simulated ward rounds. In simulation ward rounds a large number of tasks require to be prioritised for a relatively small number of patients, while medical TDGs require prioritisation amongst a larger, more representative, patient load. Whilst prioritisation was required in generic TDGs, generic TDGs did not require students to think as they would be required to in real-world clinical situations.

Another consideration was student engagement in the activity. All eligible students had voluntarily participated in a medical TDG session in Chapter 5 and had engaged

with the activity. However, there was a risk that a minority of students would not value the generic TDGs and this could potentially compromise the activity. For example, a minority of students had engaged less well with the generic TDGs in Chapter 3. Generic TDGs required the facilitator to make the clinical relevance of the activity explicitly clear, with the audio clip of the junior doctor describing her experience of looking after a critically unwell patient as a part of that strategy.

The detailed facilitator notes developed for the medical TDGs would also enable sessions to be delivered in a consistent and quality-assured manner by appropriately trained facilitators. Such guidance had not yet been developed for generic TDGs.

One further potential benefit of medical TDGs was their versatility. If a sustainable programme of medical TDGs could be delivered then in due course it may also be feasible to develop and sustain programmes of specialty-specific TDGs in other parts of the curriculum.

### **6.3.2 Identifying an opportunity in the curriculum**

The next question concerned when to run the acute medical TDG sessions. Student feedback in the focus groups in the study described in Chapter 5 had suggested that the clinical assistantship would be an ideal time to run sessions. The clinical assistantship is a period during which senior students in their run up to qualification spend time as an assistant to a junior doctor, with defined duties under appropriate supervision (GMC 2009). As such, the focus of the assistantship is on preparation for practice and learning the day-to-day skills of being a Foundation doctor, such as

managing tasks, ordering tests and handing over patients. Given that the medical TDGS were about real medicine in the real world, all be it simulated, it was felt that this late stage of the curriculum was the ideal place for them to be introduced. Up to and including 2016, the clinical assistantship in the Edinburgh curriculum comprised a three week block in March of the final year in which students attended a clinical placement and a number of workshop sessions. It was recognised that a major challenge would be delivering a medical TDG session to the full final year cohort (rather than a small number of students as in the study described in Chapter 5) within this tight time period. I met with the Year 5 Director and described to him the objectives and scope of the project. It was agreed that medical TDGs should be a core component of the clinical assistantship taught programme. The Year 5 Director also suggested that Clinical Teaching Fellows (CTFs) would be ideally equipped to deliver medical TDG sessions, and this is discussed later in this chapter.

Hitherto, all of the medical TDG sessions had been run with groups of six students, enabling students to work in a single group and to actively participate in both scenarios. However, it was recognised that group size would need to be larger to enable sessions to be delivered to the full year cohort over a three week period. We decided to compromise on a maximum group size of 12, which would require no more than 24 sessions to be delivered in a single assistantship period.

### **6.3.3 Identifying suitable facilitators**

A team of facilitators needed to be identified and trained. Sessions could be run with a single facilitator, though further realism could be added by the presence of a

second facilitator to assist, for example, with making and receiving telephone calls. A second facilitator would also enable larger groups to be divided into two subgroups with each facilitator observing a sub-group in parallel. Observing two subgroups simultaneously had previously proven very challenging in the generic TDG pilot.

The Year 5 Director identified Clinical Teaching Fellows (CTFs) as potential facilitators. These are experienced doctors, usually at least four years post-graduation who have taken one or two years time out from clinical training to focus on the development and delivery of teaching.

#### **6.3.3.1 Medical TDG facilitator training session**

A training session was held with a group of four CTFs. In this session, CTFs actively participated in a medical TDG scenario followed by a discussion around my experience of running the scenarios with Year 5 students and key learning points to bring out in the debrief. Thereafter, I developed a medical TDG facilitator's guide. The guide is displayed in Figure 36.



**Figure 36 – Guide to facilitating a medical TDG session**

Thank you for facilitating a medical tactical decision game (TDG) session. The aims of this session are to develop final year students' non-technical skills (decision making, prioritisation, teamwork and shared situation awareness) through participating in a low-fidelity simulation exercise.

Format of session:

- 1) Medical TDG 1
- 2) Debrief medical TDG 1
- 3) Short discussion about NTS
- 4) Medical TDG 2
- 5) Debrief medical TDG 2

Overall the session should last around 1 hour 15 minutes.

Within each of the medical TDGs, students get a couple of minutes to read through the tasks on their own and then several minutes to consider as a group 3 tasks for which they would like additional information. Thereafter they get a few minutes to decide on their overall strategy for the management of the task. Additional tasks can be added in at any point to challenge the students, but if they are struggling it's reasonable not to add in all of the tasks. The students should feel time-pressured and will tend to need to be hurried along.

Debriefs will vary depending upon behaviours witnessed and the students' strategy for the management of the task. However, the following are a guide for topics to cover in the debriefs:

- 1) Understanding roles/responsibilities/capabilities/limitations of team members e.g. FY1/FY2/SpR/consultant/nurses/HAN team etc.
- 2) Delegating tasks.
- 3) Escalating care.
- 4) Prioritising tasks, in particular recognising that this includes but goes beyond identifying which patients are most unwell.
- 5) Developing a practical/workable solution for the management of the task.
- 6) Encouraging the students to relate the scenarios in the task to their own clinical experiences.

The NTS discussion between the tasks should be brief and really serves to introduce/reinforce the NTS framework (included in the presentation) and to relate some of the tasks and behaviours observed in medical TDG 1 to the framework.

## **6.4 Medical TDG delivery and evaluation**

Medical TDGs were introduced into the core Year 5 teaching programme in the clinical assistantship period in March 2016. 24 medical TDG sessions were delivered across a three-week period. All sessions were led by a CTF (or me). A CTF who had not attended the original training session attended a session as an observer prior to facilitating a session. A second facilitator, usually a junior doctor who had not attended a facilitator training session, attended many of the sessions. In sessions I ran with a second facilitator I divided the group into two subgroups with both subgroups actively participating in both scenarios simultaneously. In this situation each facilitator focussed on one subgroup and debriefed that subgroup. In sessions I ran on my own, I opted to run the session with a single large group to avoid the difficulties with observing two subgroups in parallel previously described.

All students were asked to complete a short evaluation form. Students were asked to rate the following on a scale from 1 (Badly/Poor) to 5 (Well/Excellent):

- Session addressed my learning needs as a final year medical student preparing for Foundation practice.
- Style of presentation successfully delivered the subject matter.
- Overall satisfaction with session.

253 students completed an evaluation form. Mean (and standard deviation) scores for each of the three domains described above are displayed in Figure 37.

**Figure 37 – Mean (and standard deviation) score in each domain**

<b>Domain</b>	<b>Mean (and standard deviation) score</b>
Session addressed my learning needs as a final year medical student preparing for Foundation practice	4.60 (0.52)
Style of presentation successfully delivered the subject matter	4.60 (0.57)
Overall satisfaction with session	4.61 (0.54)

Data from Figure 37 shows that students valued the medical TDG experience and anticipated that it would be useful with respect to preparation for Foundation practice.

Students were also asked to provide free text comments on:

- What worked well?
- What didn't work so well?
- Anything you think we should change for future sessions?

Free text comments provided few new insights that had not emerged in the focus groups described in Chapter 5. It was noteworthy, however, that several students were keen to know how the facilitators would have managed the presented scenario:

*“Would be interesting to get perspective on what you would have done differently as someone with more experience.”*

*“Would like to know how you would have prioritised the jobs.”*

Whilst this may be a worthwhile addition to the session, it is important that students recognise that the objective is to come up with a workable solution rather than a single best answer:

*“Would like a clearer answer to what was the best way to prioritise each scenario.”*

As discussed in Chapter 1, TDGs are not intended to have a single correct answer and will have a variety of potential solutions. Facilitators describing how they would have approached scenarios may provide students with a valuable alternative approach, but it should also be emphasised that there are many potential appropriate strategies.

Many students also called for smaller group sizes but this was not unexpected. As discussed earlier in this chapter, group size had been something of a compromise.

Clearly, a more in-depth evaluation using focus groups in a similar way to that described in Chapter 5 would have provided richer data about the NTS development achieved through these sessions. Nonetheless, the evaluation suggested that students valued the sessions and recognised their relevance with respect to NTS development.

## **6.5 A sustainable programme of domain-specific TDGs in the renal curriculum**

One of the interesting developments leading from this project has been interest from specialties in developing domain-specific TDGs. For example, in renal medicine a Clinical Development Fellow (CDF) expressed an interest in developing a renal-

situated TDG. CDFs are post-Foundation doctors who work in (usually) one-year posts where in addition to clinical duties a proportion of their working time is set aside for development activities. Under my supervision, the CDF developed a renal TDG session that he piloted and iteratively developed in the Year 4 renal medicine module. The nephrology TDG has now been incorporated as a core activity in the renal module with sessions now being delivered by a CTF. The developed renal TDG with accompanying facilitator notes is presented in Figure 38.

### Figure 38 – Renal TDG with accompanying facilitator notes

You are working at the Royal Infirmary of Edinburgh (RIE) and are on nights covering the renal wards (general, transplant and HDU). You are the only junior doctor (FY2) on the overnight renal team. The renal registrar is at home, but you can contact them by phone. There is also a medical registrar on-call but he has gone to A&E and is very busy. There are 2 Hospital at Night (HAN) practitioners in the hospital but they are not at the handover. Remaining team members have been working during the day and are present at handover but will be going home thereafter.

The following tasks are outstanding. Your task is to decide how you will prioritise the outstanding tasks and justify the decisions that you have made. You may ask up to 3 questions to clarify any information.

- 1) The biochemistry lab ring you to tell you that a patient has a serum potassium of 7.0 mmol/l.

*You call the ward and are told this was the patient's pre-dialysis potassium. You phone the lab back and they note there is a post dialysis sample that has just finished; the potassium came back as 4.5.*

- 2) A nurse has called you to tell you that a new patient has arrived and needs to be clerked as they are due to have a renal transplant in the morning.

*They are 50 years old and have been on the transplant list for over 1 year. Their observations are stable. They have a past medical history of HTN, T2DM and IHD. They are anxious about the upcoming operation and are keen to talk to you about the medications they are due to receive.*

- 3) The same nurse calls you again, as a patient who was clerked by the evening doctor does not have a drug Kardex. They are asking if the patient needs any medications prescribed pre-transplant as they are unsure.

*You are uncertain but remember being told at induction that there are guidelines available on the intranet to help 'work up' pre-transplant patients. You remember being told it was important for patients to have these medications. You call a colleague who kindly guides you to the relevant information.*

- 4) The evening SHO has asked you to chase a Full Blood Count for a patient. You have the patient details but forgot to write down the reason for the blood test.

*You check the bloods and realise the patient has dropped their haemoglobin from 100g/l to 70g/l. You then realise that this FBC belongs to patient number 8 below.*

- 5) A post-transplant patient (Day 3) is complaining of feeling unwell with pain around the graft site.

*It is a 60-year-old female. They have a BP of 96/60, pulse 106 and temperature of 38.4. Their urine output has decreased over the last few hours and their pain remains severe despite adequate pain relief.*

- 6) A nurse on HDU has called you, as a patient on dialysis is complaining of chest pain, but this happens 'every time they are on dialysis.' She is sure it is nothing to worry about, but needs to call you as they have chest pain.

*Their current observations are RR 18, saturations 97% on 2l, BP 100/60, HR 110. The patient's chest pain has begun to settle. You ask for an ECG, which shows sinus tachycardia.*

- 7) A post-transplant has not passed any urine in the last 4 hours, and the nursing staff are concerned.

*You ask how much fluid they have had and have been told their cannula is clogged and they were struggling to drink the 7L target they had for today. You ask the nurse to flush the catheter and 100mls of yellow urine is passed. A nurse has replaced the cannula and a bag of fluid has been put up.*

- 8) A patient who has been well during the day after a renal biopsy has started to pass frank haematuria.

*The nursing staff inform you that the patient's BP has dropped from 130/85 earlier to 100/65 now. They are on a B-blocker and their heart rate is 80bpm. You realise that the blood result you saw earlier belongs to this patient.*

- 9) A patient on HDU has a central line that has stopped working.

*They needed the central line for noradrenaline, but have not required any in the last 24 hours and are maintaining an adequate blood pressure. They are on IV antibiotics and fluids.*

- 10) You have been asked by the evening SHO to assess the fluid balance of three patients and prescribe fluids accordingly.

*Patient 1: Has a target of 4L for the day, they have managed 2L and are feeling nauseous*

*Patient 2: Has managed their target of 2L of oral intake*

*Patient 3: Has got 500mls left of their target intake of 3L*

- 11) A patient on the ward has become acutely short of breath

*They are oedematous to their sacrum. Their saturations on air are 90% with a respiratory rate of 30. The nurse informs you that for some reason their twice-daily IV furosemide dose has been crossed off today.*

- 12) The relative of a medical border has arrived from abroad and is very angry and upset. She is asking the nurses why active treatment has been withdrawn. She is demanding to speak to a doctor tonight.

*This patient lived alone prior to admission 4 weeks ago. They were admitted for investigation for poor appetite and weight loss. A CT scan showed a hilar mass and liver metastases; he was too frail for further investigation. He was thought to be too frail to go home and he was awaiting a placement in a nursing home. Unfortunately, he developed a chest infection and didn't respond to antibiotics. On the ward round today, the consultant advised for active medical treatment to be withdrawn. The patient was drowsy and was unable to discuss the decision. The relative is the next of kin, but has not seen their father in a few years.*

The renal TDG session awaits formal evaluation. However, it serves to illustrate the versatility of medical TDGs and this is discussed further in Chapter 7.

## **6.6 Conclusion**

This chapter has described the process by which a sustainable programme of NTS teaching using medical TDGs has been incorporated into the core Edinburgh undergraduate medical curriculum. A team of facilitators has been trained to deliver sessions in a manner that has been highly valued by students. Further work is required to ensure the on-going sustainability of this programme and to evaluate the NTS learning from these sessions. A further programme of NTS teaching through TDGs has been introduced in the undergraduate renal medicine module, illustrating the potential adaptability of TDGs.



## **Chapter 7: Conclusions**

This thesis has explored the exciting potential role of TDGs as an innovative and sustainable method of developing final year medical students' NTS. Generic (non-medical) TDGs, acute care simulation scenarios and medical TDGs all appear to have a role in developing NTS as part of a wider NTS strategy. At the time of writing, medical TDGs developed through this thesis have been incorporated into the core undergraduate curriculum, while NTS training through acute care simulation scenarios exists independently of work described in this thesis.

This final chapter will begin with an integrated summary of the work presented in this thesis, including how generic and medical TDGs may complement other NTS teaching. Overall strengths and limitations of the work will then be discussed. Further suggested research topics will be presented along with potential further applications of TDGs. I will reflect on how the work presented in this thesis has already influenced my professional practice and I anticipate will continue to do so in the future. Finally, I will summarise key findings along with recommendations informed by the findings of this thesis.

### **7.1 Summary of findings**

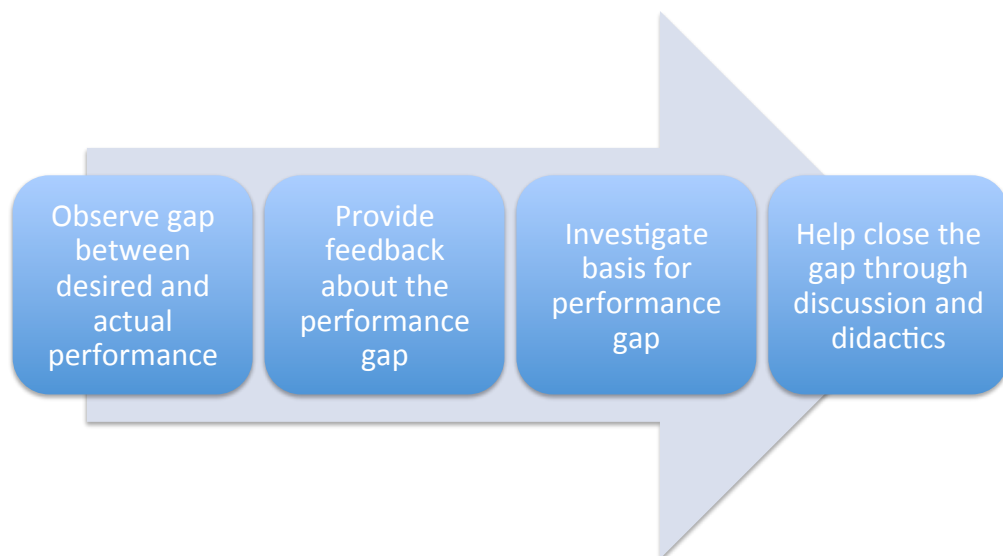
Both generic and acute medical TDGs appeared to contribute to the development of NTS though sometimes in different ways. The removal of medicine from the generic TDGs enabled students to focus on NTS and appeared to enable students less confident in their medical knowledge to engage more easily in the activity. The

absence of medical aspects also adds flexibility to generic games; for example they could potentially be used at different stages in the curriculum. Indeed, in Chapter 3 students called for their introduction much earlier in the curriculum. This would be consistent with other safety-critical industries such as aviation where NTS training is introduced from the beginning of training (Flin and Patey 2009). However, an element of caution is required before calling for the widespread introduction of generic games. Sessions would need to be carefully planned and facilitated by individuals trained in NTS. Experienced doctors working as CTFs ran medical TDG sessions in the clinical assistantship programme. In theory, non-clinicians could run generic TDG sessions, provided they were adequately trained in NTS. It is uncertain, however, whether this would lead to credible sessions that fulfilled learning objectives. Moreover, if running sessions earlier in the curriculum, particular attention would be required to make the clinical importance of NTS explicitly clear to students with relatively limited clinical experience. For example, in many UK medical schools students still have relatively limited patient contact in the first two years of medical school.

It is encouraging that both generic and medical TDGs afforded students the opportunity to give and receive feedback. Issenberg conducted a systematic review of features of high-fidelity simulation that lead to effective learning (Issenberg 2005). He found that feedback is the single most-important feature of simulation-based medical education that leads to effective learning (Issenberg 2005). Whilst this systematic review was of high-fidelity simulations, it seems likely that effective feedback would also be a key determinant of learning from low-fidelity simulations

such as TDGs. How to give feedback most effectively in TDGs remains uncertain though again experience from high-fidelity simulation may prove helpful. For example, Rudolph provided a theoretically based four-step model of debriefing for formative assessment in simulation-based medical education (Rudolph et al. 2008). This is presented in Figure 39.

**Figure 39 – Debriefing for formative assessment (from Rudolph et al. 2008)**



Although Rudolph presented a linear model, she also noted that the method of debriefing was consistent with Kolb's theory of experiential learning (Kolb 1984). Specifically, participants are encouraged to apply learning from the debriefing to similar scenarios either in simulation or real-world settings. It is evident that the

above model could also be used as a basis for debriefing in TDG scenarios.

However, a potential deficiency of the model is that it does not allow for either uncertainty or that there may be many different acceptable solutions to the presented scenario.

The work presented in this thesis has highlighted that students are uncomfortable with uncertainty and find it difficult to make decisions in uncertain situations. Cognitive psychology work suggests that there may be cognitive reasons why students fail to engage with errors and uncertainty. Perry described students' progress through various stages of epistemological growth from 'dualism' in which everything is black and white to 'relativism' where they become able to reason, recognise uncertainty and understand that judgements are important (Pilpel et al. 1998). If students have limited experience of decision-making in uncertain situations then they are more likely to remain in the dualism category. Intolerance of uncertainty is associated with generalised anxiety, as well as depression and obsessive-compulsive disorder (Lally and Cantillon 2014). Indeed, the ability of medical students to tolerate ambiguity and uncertainty in clinical decision-making appears to be a protective factor against the development of psychological distress (Lally and Cantillon 2014). Raising awareness of uncertainty and ambiguity and the need to make decisions and commit to them in the face of uncertainty can be achieved through both generic and medical TDGs. Medical TDGs have the particular advantage that they require students to make decisions in uncertain situations in a similar way in which they will require to in clinical practice. The same holds true for acute care simulation scenarios. The role of the debriefing

process will be key to teaching around uncertainty and it is noteworthy that uncertainty is not currently emphasised in the simulation debriefing literature.

Generic TDGs, acute care simulation scenarios and medical TDGs all required students to prioritise in uncertain situations. Medical TDGs provided students with a credible and realistic opportunity to prioritise a number of tasks in a time-pressured environment. As discussed in Chapter 2, prioritisation of tasks has been identified as a particularly important NTS for junior doctors, potentially more so than in other safety-critical industries (Tallentire et al. 2011a; Brown et al. 2015; Mellanby et al. 2014). This NTS is perhaps most critical for junior doctors as they require to dynamically prioritise the management of multiple patients at the same time. Whilst acute care simulation scenarios require students to prioritise within the management of individual patients, they do not usually require students to prioritise amongst different patients simultaneously. As such, the requirement to dynamically prioritise workload may be a particular attraction of medical TDGs. Medical TDGs could potentially be used in combination with simulated ward based activities to develop prioritisation skills (Harvey et al. 2015). However, large-scale simulation ward exercises are expensive and require large numbers of facilitators with expertise and specialist equipment and are therefore challenging to deliver on a sustainable basis.

Both generic and medical TDGs emphasised to students the need to work effectively in a team to develop a solution that was agreed upon and had the capacity to deliver. In both activities it was emphasised that there was no single-best solution to the scenario. This way of thinking appeared unfamiliar to many students and out of

keeping with how they require to approach, for example, examinations in medical school. Feedback from the assistantship, where some students looked for a “gold standard” solution suggests that students are unfamiliar with this way of thinking even towards the end of undergraduate training. Both generic and medical TDGs could be used to develop multi-disciplinary teamwork skills. This is underpinned by Petrie’s recommendation for “idea dominance” if a multi-disciplinary team is to succeed (Hall and Weaver 2001). Petrie argued that a clear and recognisable idea must serve as a focus for teamwork, rather than the traditional focus of each member’s domain of care. For example, in an elderly medicine ward setting, the core idea may be the safe discharge of the patient back into the community. This central idea underpins the work of different members of the multidisciplinary team, including, for example, doctors, nurses, physiotherapists and occupational therapists. In the medical TDGs the core idea is developing an agreed upon solution that has the capacity to deliver. One important caveat is that Petrie’s theory assumes that team members understand the roles and responsibilities of other team members. In the medical TDGs we found students to have a poor understanding of the roles and responsibilities of team members and ideally this should be addressed earlier in the curriculum. It cannot be acceptable for this to be learned “on the job” as this risks clinically significant mistakes being made before understanding has developed as students work in multi-professional teams and assume responsibility for patient care from the beginning of Foundation practice. It would be much better for students to learn about teamwork in an experiential way during their undergraduate training. A recent initiative in the Edinburgh curriculum is that students now spend two weeks

shadowing the healthcare teams on a ward soon after they commence clinical attachments.

In the acute care simulation scenarios, students struggled with loss of situation awareness and fixation. This is consistent with studies that have found that novices in particular tend to focus on tangible goals to the detriment of the “bigger picture” in stressful overwhelming situations (Flin et al. 2008). For example, Foundation doctors may focus on obtaining intravenous access, at the expense of escalating care or commencing treatment. Fixation errors and the importance of maintaining situation awareness could be further emphasised in generic and medical TDGs as well as in acute care simulation scenario teaching. NTS teaching should also emphasise differences between intuitive and analytical decision-making and develop metacognitive strategies to enable students to switch between different modes in real time (Klein 1998; Croskerry 2003). For example, intuitive decision-making may be appropriate when Foundation doctors are faced with a straightforward task they have experienced many times before, such as prescribing laxatives for a constipated patient. On the other hand, an analytical approach will be required when faced with a more unfamiliar scenario, such as a patient with a complex constellation of symptoms and no established diagnosis or an elderly patient with unexplained confusion.

Students appeared to find it easier to get help from peers than seniors in the acute care simulation scenarios. This is somewhat disappointing, but consistent with other studies that have described barriers to escalation of care including the impact of the

medical hierarchy (Kennedy et al. 2009a; Kennedy et al. 2009b; Stewart 2008).

Failure to escalate care has been recognised as a particular problem in surgical specialties. Johnston undertook a qualitative study exploring failures to escalate care effectively in surgical patients (Johnson et al 2014). He found failure to recognise a deteriorating patient and failure to communicate concerns to a senior colleague to be the two main barriers to escalating care. Participants identified communication skills teaching and a clearer escalation protocol to be the two best methods of improving the escalation process. TDGs represent one strategy that could form a part of such communication skills teaching. Reason identified a flattened hierarchy as a key feature of high-reliability, highly resilient industries (Reason 2000). TDGs could be used to highlight the impact of the medical hierarchy and empower students with strategies that may help them to overcome difficulties associated with overcoming the medical hierarchy. For example, this may be as simple as empowering students with the knowledge that they should always escalate care when they are concerned about a patient and should not fear rebuke from a senior colleague. However, it would be better still if the medical hierarchy were broken down so that this was no longer a consideration. NTS training also needs to focus on senior staff around creating a culture where junior staff feel able and encouraged to escalate care with senior staff viewed as approachable and supportive.

High-fidelity simulation provides an excellent opportunity to develop skills in escalating care and other NTS. Indeed, the use of high-fidelity simulation in healthcare education has increased exponentially in recent years (Issenberg et al. 2005; Motola et al. 2013). However, high fidelity simulators are expensive and



several staff members may be required to deliver sessions. As such, the cost of delivering high-fidelity simulation training is high and there is a clear need to look at other lower-cost strategies that complement high-fidelity simulation NTS training. This thesis has found both generic and medical TDGs to be low physical fidelity activities that are inexpensive to develop and deliver. Indeed, a single facilitator can run sessions following appropriate training. The facilitator training is not time onerous and no technical support is required. This is a further advantage of TDGs, compared with, for example, on-line methods of NTS training such as virtual ward environments. TDGs should also be easy to adapt to changes in clinical practice. For example, if antibiotic guidelines change no technical support is required to update the TDG appropriately.

## **7.2 Strengths and limitations**

The work described in this thesis represents the first known description of the use of generic and medical TDGs to develop undergraduate medical students' NTS. The constructivist approach taken throughout this thesis enabled me to fully acknowledge and indeed embrace the impact of my own professional background and relationship with the participants on the work done and conclusions drawn. Mays and Pope defined reflexivity as "sensitivity to the ways in which the researcher and the research process have shaped the collected data, including the role of prior assumptions and experience" (Mays and Pope 2000). Throughout this thesis I have emphasised that all of the findings are context-specific and it cannot be assumed that any of the findings are transferable beyond the study setting. Indeed, the purpose of qualitative research is to understand the perspectives and experiences of individuals

or groups and the contexts in which these perspectives or experiences are situated (O'Brien et al. 2014). I have, however, aimed to provide sufficient detail to allow others to undertake similar work in their own medical schools and to judge for themselves to what extent findings may be transferable beyond this thesis.

Rigour has been added throughout by the independent coding of the data, by a senior medical student in Chapter 3 and psychologists in Chapters 4 and 5. In each study, they have helped me appreciate the data from a different perspective and enabled new insights to emerge. For example, students being uncomfortable with uncertainty was initially brought to my attention by TL in Chapter 4. Indeed, Barbour has argued that the greatest potential of multiple coding lies in the capacity to furnish alternative interpretations and alert researchers to potentially competing explanations (Barbour 2001). In essence, the final results and conclusions represent my own interpretation of the data, informed by the insights of the other coders and of course my supervisors. It was not feasible within the timescale of the project to obtain formal participant validation of the findings described in Chapters 3-5. However, some validation will inevitably have occurred through the iterative approach to data collection and analysis, particularly in Chapters 3 and 5.

Constructivist grounded theory has informed much of the work in this thesis. The conclusions drawn are “grounded”, in the sense that they are inductively derived from empirical data, but they are also informed by prior knowledge from the literature (Lingard 2014). By theory, I simply mean “explanations for the data” (Mays and Pope, 2000). It was not my intention and I have not attempted in any of

the studies in this thesis to relate themes together at a theoretical level. Whilst there is undoubtedly overlap between and amongst themes, I felt this process risked “rewriting the studied experience into a lifeless language that better fits academic and bureaucratic worlds than those of participants”, as discussed in Chapter 2 (Charmaz 2006).

Kirkpatrick’s model of evaluation was presented in Chapter 1 as a means of measuring the impact of NTS training. Kirkpatrick’s model is presented again in Figure 40.

**Figure 40 – Kirkpatrick’s model of evaluation**

<b>Level</b>	<b>Description</b>	<b>Example Evaluation Technique</b>
Level 1 Reactions	How did participants react to the training?	Paper-based questionnaire e.g. Likert scale +/- free text response
Level 2 Learning	Whether the participants acquired knowledge, or have modified their attitudes or beliefs	Paper-based attitude questionnaire Paper-based knowledge test
Level 3 Behaviour	Assessment of whether knowledge learned in training transferred to behaviour on the job or a similar simulated environment	Observation e.g. using behavioural marker systems
Level 4 Organisation	Tangible level at an organisational level, such as an improvement in safety and productivity	Patient mortality, waiting times etc.

With respect to Kirkpatrick’s model, generic and medical TDGs appeared to impact at Level 2, with participants acquiring new knowledge and expressing an intention to modify their behaviour in the clinical environment as a consequence of NTS training. As discussed in Chapter 4, it is unclear whether participation in the generic TDGs influenced behaviour in the acute care simulation scenarios. Furthermore, whilst

students intended to apply their learning from the medical TDGs in the clinical environment, this may or may not have subsequently occurred. Measuring behavioural change is difficult as is establishing a clear cause and effect relationship between an intervention and behavioural change. This is discussed further later in this chapter.

Many medical educators have challenged an apparent over reliance on Kirkpatrick's model in health professions evaluation (Eva 2009; Haji et al. 2013; Yardley and Dornan 2012). Haji argued that Kirkpatrick's outcome-based model is too narrow a scope and cannot account for the complexities of health professions education (Haji et al. 2013). He further argued that to address the question of why and how a programme works evaluators must capture both processes and outcomes. Yardley and Dornan argued that Kirkpatrick's model does not allow for the range of outcomes that can be evaluated using qualitative methodologies, nor explain how or why such outcomes are consequential to particular elements of complex interventions (Yardley and Dornan 2012). They also questioned whether outcomes are more important than processes and noted that processes are not included in Kirkpatrick's levels. Eva argued for progress through the accumulation of empirical information that is relevant to our practical aims rather than critiquing work against a narrowly defined hierarchy of evidence (Eva 2009). The work described in this thesis has attempted to understand how generic and medical TDGs may be used in a locally situated context. The emphasis on process in addition to outcomes may enhance the wider applicability of the findings presented. Specifically, evaluation of process enables others to consider the potential transferability of TDGs to their own

domains. If, for example, TDGs were subsequently introduced as part of a large-scale intervention, such as those described by Neily and McCulloch earlier in this thesis, then this may in turn lead to meaningful outcome data at a behavioural or indeed organisational level (Neily et al. 2010; McCulloch et al. 2009).

### **7.3 Potential applications of TDGs**

This thesis has begun to explore the potential role of generic and medical TDGs to develop NTS in undergraduate medical education. However, there are further potential wider uses for TDGs. Their use need not be restricted to final year students and TDGs could be used to develop NTS throughout the medical curriculum. Non-medical TDGs could be used to introduce NTS and then medical TDGs used to emphasise their importance in clinical settings, consistent with the approach taken in other industries (Crichton et al. 2000; Crichton 2009). The development of renal TDGs has illustrated their versatility, and they could be used in various clinical specialties. For example, emergency medicine and general surgery are specialties where Foundation doctors work in highly pressured environments, and require to prioritise tasks, make decisions and escalate care in conditions of uncertainty.

TDGs could also be used in postgraduate settings both with established teams that work together frequently and also with more ad-hoc emergency teams such as the cardiac arrest team. This has been successfully implemented in other domains (Crichton 2009). TDGs could also be run with multi-professional groups, reflecting the nature of multi-professional teams in which medical professionals work in clinical practice. Participants need not be in the same physical place as TDGs could

also be run in a real-time on-line environment. This may be particularly valuable for training individuals who work in remote and rural environments and also those who may work in distributed teams across different locations. Remote delivery could also enable trained facilitators to deliver sessions to teams in the developing world.

## **7.4 Further research**

Topics for further research have been introduced earlier in this thesis. In particular, there is a need to better understand whether and how learning from generic and medical TDGs translates into the clinical environment. This could involve using acute care simulation as a surrogate for the clinical environment and assessing differences in NTS behaviours between individuals who have participated in TDGs and those who have not. However, as previously described, this would require a tool that could reliably differentiate performance. Even if such a tool were available, assessors would require sufficient training in the NTS and the tool. Flin recommended a minimum of two days training to explain and train the use of the ANTS system and this is for individuals who already understand NTS concepts (Flin et al. 2010). It is likely that a similar period of training would be required for other behavioural marker systems. Other strategies may assist in understanding transfer of learning. For example, students could be interviewed after commencing clinical practice. This may provide further understanding of the process by which students learn through TDGs. As discussed earlier, the impact of TDGs at an organisational level is only likely to be understood if they are introduced as part of a larger-scale intervention.

Further work is required to evaluate NTS learning from the core acute medical TDGs programme that has been incorporated in the clinical assistantship programme and described in Chapter 6. Sessions evaluated well, but NTS learning from these sessions was not explored in detail. Focus groups could be used to explore learning from these sessions in a similar way to that used in the study described in Chapter 5. The renal TDG activity has not been formally evaluated and this could involve a combination of a paper-based evaluation and an interview/focus group study, similar to those undertaken for medical TDGs.

How TDGs fit into a wider strategy for the delivery of NTS teaching remains to be explored. Students expressed an enthusiasm for generic TDGs earlier in the curriculum and this could be explored with groups of students. Further research could also explore NTS learning through TDGs in postgraduate settings, as described earlier in this chapter.

## **7.5 Personal reflections**

Throughout the time I have undertaken, implemented and written up the work presented in this thesis I have continued to practise clinical medicine and teach medical students and junior doctors. I have spent a considerable amount of time reading, talking and writing about NTS. I have certainly placed more emphasis on NTS in my teaching sessions, including sessions where NTS would not otherwise have represented learning outcomes for those sessions. How this period of research has informed my clinical work is harder to be sure about. Certainly, I reflect more on my own NTS than I did previously and am more aware of situations where NTS



may be particularly important. For example, I share the rationale underpinning clinical decisions much more with junior team members now than I did in the past. It is impossible to know to what extent my own NTS would have developed differently had I not undertaken the work described in this thesis.

## **7.6 Final conclusions**

This final section describes key lessons learned from the work presented in this thesis together with suggested next steps with respect to findings.

**Lesson 1 – NTS development should be emphasised earlier in the undergraduate medical curriculum and generic TDGs represent an exciting potential method of introducing students to NTS.**

NTS training is embedded from the beginning of training in other safety-critical industries. I would recommend consideration of increased NTS training from the beginning of medical school. Generic TDGs are a feasible and acceptable means of developing NTS. Students recognised the potential to use these activities earlier in the curriculum and generic TDGs could be introduced into Year 1 and/or Year 2 after identifying and training suitable facilitators.

**Lesson 2 – NTS training should continue throughout the undergraduate medical curriculum and medical TDGs could be adapted and used throughout the final three years of the curriculum as part of that strategy.**

NTS training needs to continue throughout undergraduate (and postgraduate) training and should perhaps best be regarded as a “vertical theme” running throughout the

curriculum. Medical TDGs are an exciting, sustainable method of developing NTS in the final year medicine module. The versatility of TDGs has been illustrated by the development and integration of a renal TDG into the renal medicine module. This has proven to be a sustainable method of teaching with sessions delivered by a single CTF. TDGs could be developed and delivered throughout the curriculum, with emergency medicine and general surgery key priority areas to target.

**Lesson 3 – High-fidelity simulation has a part to play in NTS development, but has to be regarded as just one part of a wider NTS strategy.**

High-fidelity simulation is an excellent means of developing NTS that is highly regarded by students. However, the use of high-fidelity simulation will always be limited by the cost of equipment and staff and therefore cannot be viewed as the only solution for developing NTS. For example, it costs around £25,000 to send a full final year cohort of around 250 students to the Scottish Centre for Simulation and Clinical Human Factors for a single day of NTS training (Skinner, personal communication). TDGs can be used along with high-fidelity simulation, simulated ward rounds and other techniques as part of an integrated strategy to develop NTS.

**Lesson 4 – Dealing with uncertainty and ambiguity should be emphasised throughout the undergraduate curriculum and medical educators must recognise and understand the difficulties many students have with these issues.**

Students are uncomfortable with uncertainty and ambiguity and find it difficult to make decisions in such situations. They are particularly vulnerable to task fixation in such situations. Moreover, negative emotional consequences of uncertainty lead to

anxiety and depression in students and Foundation doctors. Uncertainty and ambiguity therefore needs to be emphasised in NTS teaching and TDGs represent one way in which this might be done.

**Lesson 5 – Escalating care should be regarded as a key part of an NTS strategy and students require specific training in this area.**

Escalating care continues to be a problem for many Foundation doctors and failure to escalate risks unacceptable harm to patients. The importance of escalating care must be emphasised throughout training and NTS training needs to equip students with strategies to overcome barriers to escalating care. This can be achieved through TDGs, acute care simulation scenarios and ward simulation exercises as well as perhaps other novel role-play exercises. Further work is also required to overcome the medical hierarchy that persists and provides a further barrier to safe and timely escalation of care.

**Lesson 6 – Students require specific training that introduces them to the roles and responsibilities of members of the wider multi-disciplinary team.**

It is concerning that final year medical students, including those that were within a few weeks of commencing practice were unaware of the roles and responsibilities of members of the wider multi-disciplinary team, including, for example, Hospital at Night nurse practitioners. Medical TDGs are one method of providing this information, but this learning needs to occur earlier in the curriculum enabling students to use the clinical team effectively in medical TDGs and, more importantly, in clinical practice. Undertaking TDGs with different members of the multi-

disciplinary team present would enable the whole team to gain a better understanding of the roles of other team members.

**Lesson 7 – Prioritising tasks should be regarded as a fundamental NTS required by Foundation doctors and training should emphasise the need to prioritise amongst different patients.**

Much NTS training has been adapted from other safety-critical industries, particularly aviation. However, the need to prioritise tasks amongst a number of potentially critically unwell patients is of paramount importance in medicine and not reflected in current NTS teaching. Medical TDGs enable students to dynamically prioritise amongst a number of different patients, as they will require to in clinical practice. Ward simulation exercises can also be used as part of a strategy to develop prioritisation skills, but will be limited by high cost and requirement for a larger number of facilitators.

**Lesson 8 – Students and medical educators alike should be introduced to concepts of decision-making and equipped with metacognitive strategies to enable more effective decision-making.**

Understanding how decision-makers think is not currently part of the medical curriculum. Many students and indeed medical educators are unfamiliar with theories of decision making, such as dual-process theory. Embedding concepts of decision-making theory within NTS teaching would equip students with metacognitive strategies to help make better decisions in stressful situations. TDGs

could be used as part of this strategy though further facilitator training would be required before this could be recommended.

### **7.6.1 Final Summary**

This thesis has explored novel ways of developing NTS through generic and medical TDGs. TDGs have the potential to be used to develop NTS throughout the undergraduate medical curriculum and also in postgraduate contexts. They should be seen as a powerful and sustainable tool that complements existing NTS strategies such as simulation. The full potential of TDGs remains to be explored.

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## Appendix 1 – Chapter 3 consent form



The feasibility of tactical decision games (TDGs) as a novel method of teaching final year medical students.

### Consent Form

These sessions are being used to investigate the feasibility of using TDGs as a novel method of teaching NTS to final year medical students.

**Please read carefully and sign below:**

- I consent to the TDG sessions being video-recorded and the recordings used for medical educational research only.
- I understand that the recordings will be viewed only by those directly involved in this research.
- I consent to the acute care scenario session being video-recorded and the recordings used for medical educational research only.
- I understand that the recordings will be viewed only by those directly involved in this research.
- I consent to the focus group being audio-recorded and the recordings used for medical educational research only.
- I understand that the recordings will be heard only by those directly involved in this research.
- Whilst I may be quoted in educational research, I will not be identified at any stage and no comments or opinions will be attributed to me personally.
- All data obtained and processed will be done so in accordance with the Data Protection Act 1998.

Print Name

Signature

Date

Signature of researcher

Date



## Appendix 2 – Chapter 4 consent form



Exploring the role of tactical decision games (TDGs) as a novel method of teaching non-technical skills (NTS) to final year medical students.

### Consent Form

These sessions are being used to explore the utility of TDGs as a novel method of teaching NTS to final year medical students.

**Please read carefully and sign below:**

- I consent to the TDG session being video-recorded and the recordings used for medical educational research only.
- I understand that the recordings will be viewed only by those directly involved in this research.
- I consent to the acute care scenario session being video-recorded and the recordings used for medical educational research only.
- I understand that the recordings will be viewed only by those directly involved in this research.
- I consent to the video-stimulated debrief interview being audio recorded and transcribed, with data anonymised at transcription.
- I understand that the recordings will be heard only by those directly involved in this research.
- Whilst I may be quoted in educational research, I will not be identified at any stage and no comments or opinions will be attributed to me personally.
- All data obtained and processed will be done so in accordance with the Data Protection Act 1998.
- I understand that my decision to take part is entirely voluntary, has no bearing on student assessment and that I may withdraw consent to participate at any time.

Print Name

Signature

Date

Signature of researcher

Date

## Appendix 3 – Chapter 5 consent form



Exploring using medical tactical decision games (TDGs) as a novel method of teaching non-technical skills (NTS).

### Consent Form

These sessions are being used to explore the utility of medical TDGs as a novel method of teaching NTS.

**Please read carefully and sign below:**

- I consent to the TDG session being audio recorded and the recordings used for medical educational research only.
- I consent to the focus group being audio recorded and transcribed, with data anonymised at transcription.
- I understand that the recordings will be heard only by those directly involved in this research.
- Whilst I may be quoted in educational research, I will not be identified at any stage and no comments or opinions will be attributed to me personally.
- All data obtained and processed will be done so in accordance with the Data Protection Act 1998.
- I understand that my decision to take part is entirely voluntary and that I may withdraw consent to participate at any time.

Print Name

Signature

Date

Signature of researcher

Date

## **Appendix 4 – Published paper and letter**